1974

Report to the Board of Advisors

NAVAL POSTGRADUATE SCHOOL

Monterey, California

REPORT

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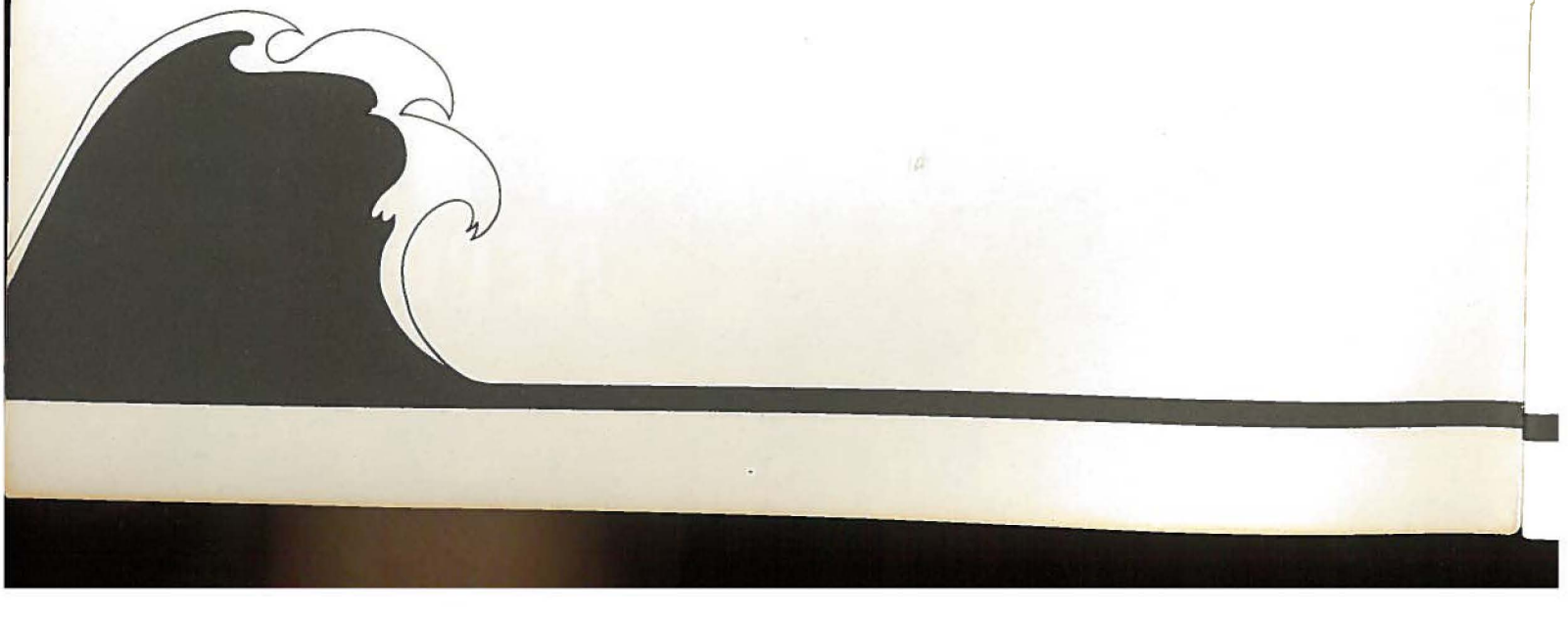

NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA

REPORT TO THE BOARD OF ADVISORS

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THE BOARD OF ADVISORS

The Secretary of the Navy established a Board of Advisors to the Superintendent, U.S. Naval Postgraduate School in 1967. The Board is composed of highly qualified civilian educators; prominent citizens from business, the professions, and other vocations; and active and retired military officers.

The purpose of the Board is to advise and assist the Superintendent concerning the Naval Postgraduate Education Program. In accomplishing this objective, the Board assesses the effectiveness with which the Naval Postgraduate School is accomplishing its mission. To this end, they inquire into the curricula, instruction, physical equipment, administration, state of morale of the student body, faculty, and staff; fiscal affairs; and such matters as the Board considers pertinent.

THE SUPERINTENDENT'S MESSAGE

This Report to the Board of Advisors presents in brief form the recent activities and accomplishments of the faculty and students of the Naval Postgraduate School. It summarizes the special educational programs that have been developed here to meet the Navy's need for officers with advanced technical, scientific and administrative capabilities. This year has been a period of recognition and accomplishment for the Naval Postgraduate School. Our educational and research programs are based on the dual principles of academic excellence and relevancy to Navy requirements. Our officer graduates have demonstrated their effectiveness in all aspects of naval progress. We believe our programs are sound. Nonetheless, their content is continually under review to insure educational sequences which will fit each officer's academic background and prepare him to meet the modern challenges of a naval career.

The Navy's graduate educational programs have been developed to provide a small percentage of selected, fleet-experienced officers with advanced technical, scientific and administrative education in areas directly related to naval operational and technological progress. Two general factors govern all considerations of naval educational requirements: first, the Navy is a technical service, relying for its effectiveness on imaginative and informed application of scientific knowledge and technological progress to operations at sea; and, second, naval personnel must live, operate and perform in the environment of the world's oceans, an environment far different from that encountered in other occupations. These two factors have led to the naval educational programs at the Naval Postgraduate School.

The first graduate program, introduced over 65 years ago, provided advanced study in Naval Engineering. Since that time, the exponential growth of technology and its direct essential application to Navy combat systems have broadened the Navy's professional requirements to include such developing fields as computer science, electronics, weapons engineering, aircraft design, oceanography, meteorology, and many more. Professional naval officers of today, those who can guide the Navy along new paths of tactical effectiveness, must understand the principle of underwater physics, the factors that govern weapons control, the methods of operations analysis, and the other scientific laws and analytical techniques that guide our operational progress.

With this requirement for advancement in operational capability goes a companion requirement for effective and economical procurement of the weapons systems needed by the Navy. Professional naval officers must know how fleet requirements can be translated into efficient procurement action, and this specific educational requirement has led to programs in naval procurement project management.

In all cases, the equipment, weapon system, and operating personnel must perform effectively under conditions actually encountered at sea. Weapons and machinery must be designed to withstand a winter gale in the North Atlantic. Naval aircraft must be capable not only of shipboard launching and recovery, but also must use materials that resist the corrosive effects of sea spray. Underwater acoustic detection systems must be effective against submarines in the Gulf Stream as well as in the Gulf of Alaska. These and many other factors describe today's challenges for the professional naval officer and determine the directions of advancement for naval technology. They also define the education requirements that must be met by the Navy's graduate education programs.

The curricula at the Naval Postgraduate School provide programs in each technical area which are specifically directed at naval requirements, make full use of the officers' experiences at sea, and are firmly based on academic excellence in examining and adapting the continuing developments of science, technology and analysis.

This past year has been a time of surveys, investigations and analyses of the Navy's graduate education program. The Congress, in the Fiscal Year 1974 Department of Defense Appropriation Act, made general reductions in educational funds for all services, and provided additional guidance for these educational efforts. This sudden attention to a subject that had been for years a matter for individual service determination has spawned a number of studies that have examined all aspects of education policies. The

results of these efforts are not yet all in, but they have caused the Navy to examine more carefully its requirements for officers with advanced education and state more clearly its policies and goals.

Programs offered at the Naval Postgraduate School are described in this Report, and recent developments—program reviews by naval sponsors, newly introduced material, development of new instructional methods, general research directions, student and faculty achievements and recognition, etc.—are summarized in departmental and curricular sections.

This is a report on the Naval Postgraduate School today. It is also a report on the direction of our programs as an important component of the United States Navy.

ISHAM LINDER
Rear Admiral, United States Navy
Superintendent

Isham Linder, Rear Admiral, U.S. Navy
Superintendent, Naval Postgraduate School

A Naval Academy graduate and a naval aviator, RADM Linder has commanded USS Cleveland (LPD-7), USS Intrepid (CVS-11), and Air Anti-Submarine Squadron 25. After promotion to flag rank, he was assigned as Commander Cruiser Destroyer Flotilla Two. RADM Linder holds the Ph.D. in Engineering Sciences from the University of California at Berkeley. He has qualified as a naval nuclear propulsion supervisor by study at the Naval Reactor Training Schools at Mare Island, California and the National Reactor Testing Station, Idaho. In his last assignment, before coming to Monterey, RADM Linder served in the Office of the Chief of Naval Operations as Head of CVA (N)—Nuclear Powered Aircraft Carrier—Coordination.

THE PROVOST'S MESSAGE

The last year has been a year of continued progress by the NPS faculty toward excellence in education, research and service to the Navy. New initiatives are best exemplified by the establishment of a Continuing Education Program. This program, I believe, will contribute significantly to the Navy's mission in the future. Its essential components of academic counseling, basic courses given off-campus to shorten the officer's time in fully-funded education and an update course given on- and off-campus are described in more detail later in the report. This innovative activity is responsive to Department of Defense guidance on Graduate Education and current academic trends toward using non-traditional modes of instruction.

The Naval Postgraduate School's faculty have been active both in academic and in government circles. Several faculty members have been elected or appointed to high positions in professional and scholarly societies, including the presidency of two. Several more have been honored by professional societies by being named Fellows or by having their research cited. Many have been recognized by various offices in the Navy for their professional efforts.

The importance and relevance of our research was highlighted last year by the incorporation into an advanced Navy system of NPS-developed special purpose signal processing techniques. The significance of the basic research effort is indicated by the citation, for the second year in a row, of certain faculty publications as important new developments in Physics. A new research Chair, sponsored by the Chief of Naval Operations (Systems Analysis Division), was established in 1974.

Recently renewed emphasis has been placed on faculty experience tours. In these tours, the faculty member will spend three months to a year working on research problems in a Navy or DOD organization. The tours add to the faculty's knowledge of Navy problems and foster closer cooperation between the School and the various program sponsors.

In the personnel area, Dr. R.R. Fossum, formerly Vice President of ESL Incorporated, was named Dean of Research. Dr. W.M. Woods, formerly Chairman of the Department of Mathematics, was named Dean of Educational Development and Executive Director of the Continuing Education Program. New Departmental Chairmen include Professor D.A. Schrady, Department of Operations Research and Administrative Science; Professor Ladis Kovach, Department of Mathematics; and Professor K.H. Woehler, Department of Physics and Chemistry.

The many current pressures on graduate education indicate that the coming year will present the faculty with many challenges. As in the past, the faculty's technical expertise, educational creativity, and familiarity with Defense problems will provide the Navy with valuable assistance in meeting these challenges.

JACK R. BORSTING
Academic Dean/Provost

Jack R. Borsting, Ph.D.
University of Oregon
Provost and Academic Dean

Dr. Borsting was appointed to the School's top academic post on January 1, 1974. He is presently president of the Operations Research Society of America (ORSA). He is a past president of the Military Operations Research Society and is a Fellow of the American Association for the Advancement of Science. He has been an Advisory Board Member of the Naval Personnel Research and Development Center, San Diego; a Planning Committee Member, Unified Science and Mathematics for Elementary Schools, Educational Development Corporation (National Science Foundation Project); and U.S. Representative, International Committee for NATO Conference on Education in Operations Research.

ACADEMIC AND PROFESSIONAL PROFILE OF STUDENTS

Naval officer students at the Naval Postgraduate School cover the span of ages from 21 to 44 and range in rank from ensign to captain. The majority are Navy lieutenants, whose average age is 29 years. This varies somewhat among the various curricula—the "average" student studying Computer Science is a 28-year-old lieutenant, while the "average" student in the Systems Acquisition Management curriculum is a 32-year-old lieutenant commander.

Of 948 naval officer students at NPS in July 1974, 729 (76.9%) were Unrestricted Line Officers while 219 (23.1%) were Restricted Line and Staff Corps Officers.

All students (except for those few selected for the Navy's Immediate Graduate Education Program) have had fleet operational assignments. The "average" student has had 6.2 years of active naval service before being ordered to NPS. Demonstrated excellence in professional naval assignments is one of the two criteria and, indeed, the most important consideration employed in the selection of students. Those selected are, first of all, experienced naval officers who have shown that they are dedicated to improving the technological and professional capability of the Navy. The second criterion is one of academic proficiency. Those selected have shown by the quality of their previous college-level studies that they can complete a graduate program.

Some officers selected for graduate programs may have had an undergraduate major in a different field from that of their graduate studies. In fact, certain distinctive naval graduate programs have no standard undergraduate counterparts. Of the 59 naval officers studying engineering electronics at NPS, for example, 31 (53%) had undergraduate degrees in the same general field, 14 (23%) had degrees in related areas such as physics and mathematics, and 14 (23%) had undergraduate work in other fields (chemistry, education, communications). The anti-submarine warfare curriculum is an example of a naval program without any undergraduate counterpart. Of the 48 officers studying in this curriculum, 25 (52%) had undergraduate studies in generally related areas such as mathematics, naval science, electrical engineering, chemical engineering, mechanical engineering and physics. The other 23 officers had previous educational experience in other areas (zoology, metallurgy, industrial management, psychology, modern languages).

In all cases study programs are developed individually so that each officer begins his work at a point in the program which is compatible with his previous education and experience.

Donald W. Kiley, Captain, U.S. Navy, Aeronautical Engineer
California Institute of Technology
Director of Programs

Captain Kiley reported to the Naval Postgraduate School from an assignment as Commander, Destroyer Squadron Twenty-Four with the Atlantic Fleet. He has served as Chief of the Military Assistance Plans and Policy Division on the joint staff of the U.S. Southern Command; Head, Missile Propulsion Section in the Special Projects Office (POLARIS); and Head, Program Planning Branch in the Surface Missile Systems Project Office. Captain Kiley has commanded the ammunition ship MAZAMA, the destroyer WADLEIGH and the LST RICE COUNTY.

Wilbert F. Koehler, Ph.D.
The Johns Hopkins University
Dean of Programs

Dr. Koehler has served in his present position since August 1962. In 1951, he joined the U.S. Naval Ordnance Test Station, China Lake, Ca. as a research scientist and, later, became head of its Physics Division. His research interests have centered in the area of multiple-beam interferometry. He is a fellow of the Optical Society of America, and a member of the American Association of Physics Teachers, American Physical Society, American Society for Engineering Education, and Sigma Xi.

THE NAVAL POSTGRADUATE SCHOOL TODAY

- **Educational Programs**

Curricular programs have been established at the Naval Postgraduate School in specific areas of naval technical, scientific, and administrative interest. The programs offered are:

Operations Research/Systems Analysis	Naval Engineering
Computer Systems	Naval Intelligence
Computer Science	Underwater Acoustics
Meteorology	Engineering Electronics
Oceanography	Communications Engineering
Advanced Science	Aeronautical Engineering
Anti-Submarine Warfare	Telecommunications Systems
Weapon Systems Technology	Systems Acquisition Management

Administrative Science

The Naval Postgraduate School is on a 12 month academic year, with four quarters per year.

- **Student Body**

The 1974 quarterly average enrollment was:

U.S. Naval Officers	1051
U.S. Marine Corps Officers	39
U.S. Army Officers	33
U.S. Air Force Officers	4
U.S. Coast Guard Officers	32
NOAA Officers	1
International Officers*	192
Total	1352

*Nations represented: Australia, Brazil, Cambodia, Canada, Chile, China, Colombia, Germany, Greece, Indonesia, Iran, Israel, Japan, Korea, Norway, Pakistan, Peru, Phillippines, Portugal, Singapore, Thailand, Turkey, Vietnam.

- **Faculty**

The faculty is composed of 87% civilians and 13% military officers. Eighty-two percent of the civilian faculty members have their doctorates. Civilian faculty members tend to remain with the Naval Postgraduate School and all work aggressively through research projects, tours with naval laboratories, and visits to naval activities to remain abreast of current naval operational requirements and developments. The average length of association with the Naval Postgraduate School for the civilian faculty is ten years. The military faculty members, 98% of whom hold advanced degrees, are assigned to the Naval Postgraduate School for a normal tour of about three years.

- **Student Completions**

	USN		Other U.S.	International	Total
	Undergraduate	Graduate	Graduate	Graduate	
FY 73	163	602	91	71	927
FY 74	161	464	49	64	738
FY 75*	116	495	75	56	742

*Projected

REPORT ON ACADEMIC DEPARTMENTS

AERONAUTICS

In response to the new emphasis on continuing education and the flexibility implied by that concept, the Department of Aeronautics has begun to redesign aeronautics courses into a self-instructional format. The new design will facilitate matriculation of new students at any time of the year and will make it possible to offer some courses to officers at off-campus duty stations.

Departmental research has included work on a more survivable aircraft fuel tank; the analysis of arbitrarily loaded shells of revolution, a program which was instrumental in expediting AEC/TVA construction of a new nuclear electric generating plant with great cost savings; operation of a full-scale captured air bubble ship; testing of such composite materials as fiberglass or graphite and epoxy, with a study of the effects of lasers on such materials; assistance in the design and analysis of new arresting gear engines that are being developed by the Naval Air Engineering Center; behavior of solid propellants during burning under special conditions; wind tunnel tests of V/STOL aircraft; and the generation and tactical use of airborne high energy laser beams.

Five symposia involving the department were held at NPS during the past year with more than 2000 participants. Among these were the AIAA Strategic Offensive/Defensive Missile Systems Meeting, and the NASA-USN Lighter-Than-Air Workshop, which received national recognition.

Two faculty members have recently served with the Naval Air Systems Command. Professor L. V. Schmidt began a one-year appointment in July as Deputy Aerodynamics, Structures and Materials Administrator, and Associate Professor M. F. Platzer spent one quarter as a special on-board consultant, both with the Research and Technology Directorate of the command.

Professor A. E. Fuhs has served as editor of the *Journal of Aircraft* of the American Institute of Aeronautics and Astronautics since January, 1974. He and other faculty members have been active in reviewing technical articles for publication in the journal, presenting seminars before outside groups, organizing symposia, editing their proceedings, representing the Navy on NATO AGARD panels and directing its lecture series, and giving presentations at professional meetings. The faculty have also produced many technical reports, papers and books during the year, some of which are listed elsewhere in this report.

Richard W. Bell, Ph. D.
California Institute of Technology
Chairman,
Department of Aeronautics

Dr. Bell has been active for many years as a consultant to major industries in aircraft and aerospace fields, both in the design of test facilities applied in development of the X-15 research aircraft and on aerodynamic structural applications to flight vehicles and propulsion. He is a member of the Institute of Aerospace Sciences, the American Rocket Society and Sigma Xi. Professor Bell is Chairman of the Citizens' Educational Study Committee of the Carmel, California Unified School District.

COMPUTER SCIENCE GROUP

The faculty of six civilian professors and six naval officers taught 44 different courses during the last year. These ranged from basic computer science/programming and other "service" courses for all departments to graduate level specialty courses such as Compiler Design and Implementation. The number of students enrolled exceeded 1200.

In the areas of research and facilities, there have been two significant advances. First was the development of a "micro" laboratory for hardware/software study in the microcomputer area. Among several projects in the laboratory was the development of a "no drop" bomb system, which was successfully demonstrated at the Naval Weapons Center, China Lake, in November. If further testing and evaluation prove the system a success, training commands will no longer be required to provide bomb ordnance, thus realizing substantial final savings. The second notable advance was the installation at NPS of signal processing equipment under the direction of Professor George Rahe, supported by an ASW research grant. When not being used for research, the equipment is available to students and faculty for hands-on experience. The system utilizes the latest technology in medium-sized computer systems.

In the Continuing Education area, several computer science short courses have been designed to serve as refresher units and for updating of officers in the field. Others were designed for particular DOD groups that had requested them. The first of these, a one-week presentation on structured programming, was given at Fleet Combat Directions Systems Support Activity, Dam Neck, Virginia, in June.

Gerald L. Barksdale, Jr., M.S.
University of Wisconsin
Chairman, Computer Science Group

Professor Barksdale's research interests include computer systems design, computer system performance measurement and evaluation, interactive computer system design, computer graphics, and educational utilization of computers. He is a member of the Institute of Electrical and Electronics Engineers, Inc., the Association for Computing Machinery, and Sigma Xi.

ELECTRICAL ENGINEERING

The Electrical Engineering Department continued to broaden its scope of related military research through support of interdisciplinary and sponsored departmental projects. Detailed review of course structure and content has resulted in a more effective and relevant grouping of specialized courses to provide for the needs of students.

The field of electrical engineering continues to become more specialized in its programs, more sophisticated in its equipment and more involved with other disciplines in its concepts. As evidence of this continuing progress, the department has recently designed and taught 15 new courses. These range from "Introduction to Signals and Noise" to "Marine Electrical Analysis and Design." The need for several of these courses evolved from the development of new curricula (Anti-Submarine Warfare, Weapon Systems Technology) in which the department is involved. Others reflect new areas of Navy interest and a few are consolidations of other courses, designed to shorten student time at NPS.

In addition to expanding its course offerings, the department also expanded its doctoral program to offer the degree of Doctor of Engineering (Dr. Eng.). The degree is designed for candidates whose career objectives center around design, development and technical management, as opposed to the pure research orientation of the typical Ph. D. program. A candidate for this degree may include an internship of one year at either governmental or industrial organizations as part of this program.

Another innovation adopted was a faculty exchange with the U. S. Naval Academy. Professor Harold Titus of NPS and Professor Edward Waller of the Academy changed places for the year. The student bodies of both institutions are expected to benefit from this exchange of teaching personalities with their unique academic interests.

Faculty and student research continued at a high level and emphasized work on practical Navy problems. One example is a proposed integrated launch and recovery TV surveillance system to replace the existing Pilot Landing Assistance Television system (PLAT) on aircraft carriers, researched by Professor Paul Cooper and his systems engineering class. Another was a study by Professor John Duffin of airborne pollutants generated by naval installations. Several aspects of anti-submarine warfare also received research emphasis. Associate Professor John Ohlson began preparation of the Navy Satellite Communications Handbook for NAVELEX as a sponsored research project.

In addition, faculty members continued to publish in professional journals. Examples are Professor S. Yakowitz's article "Multiple Hypotheses Testing by Finite Memory Algorithms," in *The Annals of Statistics*, and Professor J. B. Knorr's "The Effect of Surface Metal Adhesive on Slot Line Wavelength," in *IEEE Transactions on Microwave Theory and Techniques*. Two textbooks were also produced, *Electric Circuits and Networks*, by Professors R. S. Strum and J. R. Ward, and *Design of Feedback Controls*, by Professor G. J. Thaler.

Professor S. R. Parker, department chairman, has been elected president of the IEEE Circuits and Systems Society and has also been chosen as a Fellow of the IEEE.

Sydney R. Parker, Sc.D.
Stevens Institute of Technology
Chairman, Department of Electrical Engineering

A Registered Professional Engineer, Dr. Parker is a founder of the Annual Asilomar Conference on Circuits and Systems. He has served as an Associate Editor for a special issue of the IEEE Transactions, is a member of the IEEE Committee on Computer-Aided Network Design, and was Chairman of the 1972 IEEE International Symposium on Circuit Theory. Dr. Parker has been chosen a Fellow of the IEEE. He is a member of the American Association for the Advancement of Science, the American Association for Engineering Education and numerous other professional societies.

GOVERNMENT

The year 1974 marked an important transition for the Department of Government. The department's major responsibility was transferred from the undergraduate BS/BA curriculum (terminated by Congressional action) to the new Naval Intelligence curriculum. The department administers the new curriculum and teaches about half of its courses. Since the department will no longer teach courses in English and psychology, the word "Humanities" was dropped from its title and it became the Department of Government.

Phaseout of the BS/BA program was begun with a decline in enrollment from about 200 students to less then 100. Final closeout of the program is scheduled for June 30, 1975.

The department also devoted considerable effort to the development of new curricula in the field of national security affairs. National Security Affairs with Area Specialization is designed so the student can spend the first year at NPS and the second year at Monterey's Defense Language Institute studying a foreign language.

The department joined the Continuing Education program with the shaping of Navy-relevant courses in the field of National Security Affairs, to be given off-campus, under the direction of Professor Donald C. Daniel.

Research and writing remained an important part of faculty activities. Professor Stephen Gottschalk's book *The Emergence of Christian Science in American Life* was published by the University of California Press. Lieutenant Mark W. Janis' research on the law of the sea resulted in the publication of articles in the *Naval Institute Proceedings* and the *Naval War College Review.* He also co-authored a paper, "The U.S.S.R.: Ocean Use and Ocean Law," published by the Law of the Sea Institute. Lieutenant Janis represented NPS in Washington, D.C. in April in two workshops on the Law of War, one sponsored by the American Society of International Law and the other by the Army Judge Advocate General. He and Professor E.J. Laurance were assigned a quarter in Newport, R.I., as Associates of the Department of Advanced Research at the Naval War College. Professor Daniel devoted a quarter in Washington to developing his course "Soviet Maritime and Naval Strategy," working with the Center for Naval Analyses and other government agencies.

Professor R.H. Stolfi was sent by the United States government to the Middle East, where he helped evaluate the results of the 1973 Arab-Israeli War and especially the results of the tank warfare. Professor J.W. Amos completed his investigations for Naval Intelligence on the Arab strategies in the 1973 war and Professor Frank M. Teti continued his Study of the National Interest. Professor Daniel and Lieutenant Janis organized and conducted an NPS Symposium on Naval Operations and the Changing Legal Order of the Oceans in conjunction with Georgetown University.

Boyd F. Huff, Ph.D.
University of California
Chairman,
Department of Government

Dr. Huff has specialized in Asian history and affairs, recent American diplomacy, and National Security Affairs. His teaching experience includes faculty assignments at the University of California, San Francisco State College, the University of Arizona and the University of San Francisco. He is a member of the International Studies Association, Asian Studies Association, American Political Science Association, and the American Historical Association.

MATHEMATICS

Efforts of the Department of Mathematics have been directed toward the design of new courses, adaptation of several courses to the Personalized System of Instruction (PSI), faculty research and publishing.

New curricula have dictated development of new mathematics courses to fit their requirements. Two such courses were designed by Assistant Professor T. Jayachandran for use in the Naval Intelligence and Weapons Systems Technology curricula. He also established two short courses, one on the Design of Experiments and the other on Reliability Methods. The latter was given for the first time in February 1975 at the Naval Weapons Station in Seal Beach, California, as part of the NPS Continuing Education Program. Under that same program, Professor Maurice Weir developed a course in linear algebra in PSI.

To condense NPS curricula, a phaseout of refresher courses in mathematics was begun. Self-instructional courses, developed to take their place, can be taken by prospective students in advance of their arrival at NPS. In addition, a calculus diagnostic examination was developed by Lieutenant junior grade Robert Bamford, a mathematics instructor, which is proving valuable for placement and for assigning remedial work where

needed. These efforts have been undertaken to shorten a student's time at NPS.

The faculty have continued to fulfill applied Navy requirements in research. Notable work was accomplished by Professors C. Comstock and P.C. Wang on computation of sound propagation in the ocean. Professor B. Russak worked on a classified research problem for the Naval Missile Center at Point Mugu, and Distinguished Professor F. Faulkner worked under a contract with the Environmental Prediction Research Facility to complete specific mathematical formulations. Professor Arthur Schoenstadt spent a quarter as visiting professor at the Naval Telecommunications Command in Washington.

Among faculty publications was an article by Professor Robert Gaskell presented in the *American Mathematical Monthly*, "The Industrial Mathematician Views His Profession," which received international attention. Professor Weir completed his book, *Hewitt-Nachbin Spaces*, which will be published in mid-1975 in the Notas de Matematica series of North Holland Press.

Professor Gaskell was elected chairman of the Mathematics Division of the American Society for Engineering Education. He is also chairman of the corporate members' committee of the Mathematical Association of America. Other faculty members serve on editorial boards and as reviewers for *Simulation*, *SIAM*, and *Mathematical Review*.

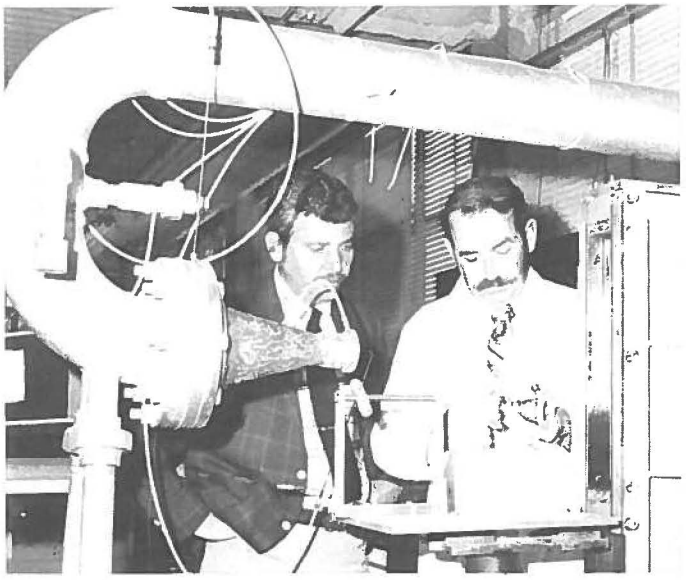
Ladis D. Kovach, Ph.D.
Purdue University
Chairman,
Department of Mathematics

Professor Kovach, formerly Chairman of the Department of Mathematics and Physics at Pepperdine College, is a registered Professional Electrical Engineer. He is a member of Sigma Xi, the Mathematical Association of America, Simulation Council and Association Internationale pour le Calcul Analogique, and is on the editorial board of *Simulation* and a reviewer for Computing Reviews.

Professor Kovach also has extensive industrial experience, chiefly in electronics. He was associated with Picker X-Ray Corporation, American Shipbuilding Company and Ohio Crankshaft Company, and was a staff specialist in analog computing at Douglas Aircraft Company.

MECHANICAL ENGINEERING

There have been significant developments in all aspects of the operations of the department. The number of students enrolled in Mechanical Engineering Programs has increased to a level that is well above the long-term average for the department. The integration of the Materials Science Group into the department was successfully completed, including the transfer of two outstanding professors to the M.E. faculty. Research projects have increased.



The department has planned nine short courses to be offered in the Continuing Education Program. Included are Energy, People, and Machines; Heat Pipe Technology; and Shock and Vibration in Naval Structures. In addition, work was begun to prepare four prerequisite courses in special self-paced format for presentation at off-campus sites.

The base of research in mechanical engineering was extensively broadened. The M.E. faculty became increasingly involved in research and exploratory engineering efforts in response to Navy needs. A broad spectrum of agencies including ONR, NSF, NAVSEA, NAVAIR, NSWC, NWC, NUC, NELC and CEL have contributed to the support of the research efforts of the department. A major ingredient of these activities has been the extensive interaction of the faculty and students with these sponsors, including practical experience tours with Navy R&D activities. Major new research facilities, including scanning and transmission electron microscopes, have been added through these research efforts.

The faculty has maintained an extensive involvement in national and international professional activities. Professor Gilles Cantin spent his 1974 sabbatical at the University of Wales, the Technical University of Norway and the Ecole Polytechnique in Paris. Professor R.H. Nunn has been selected for a 15-month term as ONR Visiting Scientist in London. In addition, several research papers were presented abroad and other faculty have made extended visits to major European campuses. Closer to home, the M.E. faculty continue to hold positions of responsibility on national executive and editorial boards, councils and committees. Professor T. Sarpkaya is Associate Editor of the *Fluid Engineering Journal* of the American Society of Mechanical Engineers. Professors J.E. Brock and R.E. Newton have been elected Fellows of the

American Society of Mechanical Engineers, and Professor Paul Pucci has been chosen a member of the Society's Executive Committee (Gas Turbine Division). Continuing efforts to coordinate programs with the Naval Academy have led to a one-year tour of duty by Professor P.J. Marto with the mechanical engineering faculty at Annapolis. A total of seven faculty and students have gained California certification as Professional Engineers.

Major plans currently in development include an interdisciplinary broad-based program of research in energy conversion, transmission and utilization, under the sponsorship of NAVSEA; the establishment of a visiting professorship in mechanical engineering and the design of programs to serve the educational needs of the civil engineering community.

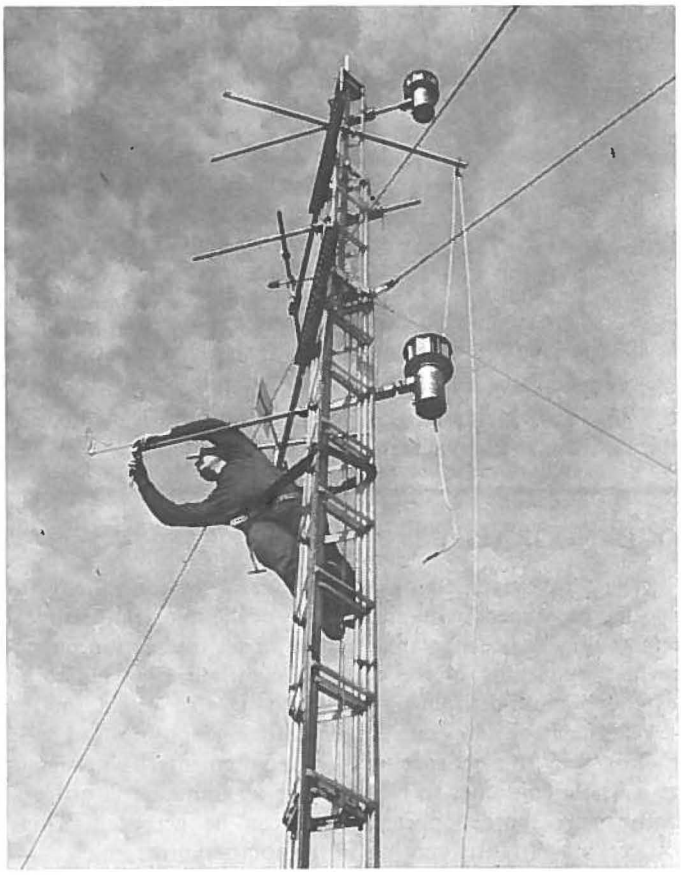
Robert H. Nunn, Ph.D.
University of California at Davis
Chairman, Department of Mechanical Engineering

Dr. Nunn was formerly a Research Aerospace Engineer at the Naval Weapons Center at China Lake, California. There, he was manager of two major Navy research projects and served as a member and, later, chairman of the Nozzles and Jet Effects Panel of the Naval Aeroballistics Advisory Committee. Dr. Nunn is a member of the American Institute of Aeronautics and Astronautics, American Society of Mechanical Engineers, American Society of Electrical Engineers and Sigma Xi.

METEOROLOGY

The most important recent innovation introduced into the Meteorology Department has been the development and presentation of a Continuing Education Short Course designed for Meteorology specialists at the request of the Commander, Naval Weather Service. The purpose of this course is to update officers who previously received a master's degree in meteorology at NPS by five or more years. It presents a survey of recent developments in the field, ranging from satellite meteorology to weather modification effects of pollution. Sixteen officers attended the first offering of the program in the Spring, 1974. Instructors teaching this program were primarily from the staff and faculty at NPS, while others came from Fleet Numerical Weather Central, the Environmental Prediction Research Facility, and several agencies outside the local area. The course will be repeated in the Spring, 1976 in response to requests from several naval commands.

Faculty and student research on Navy related meteorological problems has been extensive. A typical example is Professor R.J. Renard's development of a scheme to increase the accuracy of the analysis and climatology of fog over the Pacific Ocean. It is expected eventually to improve prediction of marine fog and be extended to other ocean areas. Another is the development of a computerized global atmospheric prediction model by Professor G.J. Haltiner and R.T. Williams in conjunction with Fleet Numerical Weather Central. This will replace the latter's operational hemispheric model and give that organization a global forecasting capability.



Professors R.L. Elsberry, R.J. Renard and CDR Jerry Jarrell have devised improved methods of forecasting the movement and intensity of hurricanes and typhoons. These techniques are being used by both military and civilian agencies in the eastern and western Pacific Ocean Areas.

Numerous other military-related projects are being pursued, most of which have resulted in the publication of papers and technical reports, in addition to fulfilling thesis requirements. Lieutenants Don Mautner, Mike Brown, Jack Douglass, Dieter Rudolph and Lieutenant Commander Russ Graff have completed comprehensive studies of seven important harbors in the western Pacific as typhoon havens. These thesis are being circulated to Navy ships to assist their commanding officers in seeking refuge from severe storms.

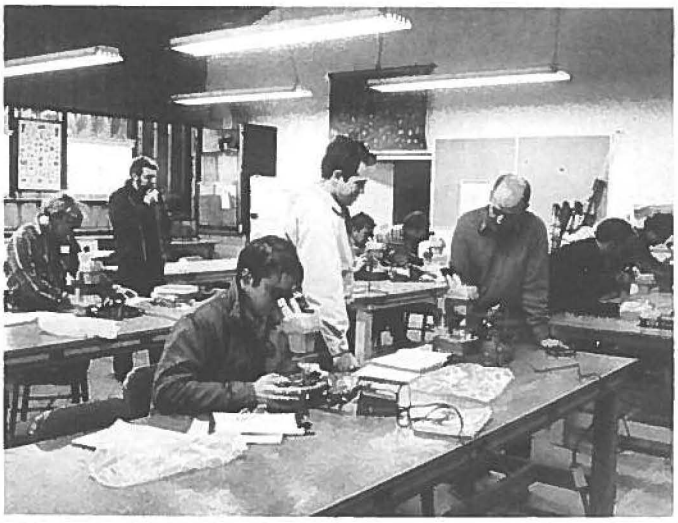
George J. Haltiner, Ph.D.
University of Wisconsin
Chairman,
Department of Meteorology

Dr. Haltiner has published more than 20 research articles on dynamic and synoptic meteorology. He is the author of the textbook *Numerical Weather Prediction* and co-author of another text, *Dynamical and Physical Meteorology*, both of which have been widely used in this country and abroad. He is a Fellow of the American Meteorological Society and foreign member of the Japanese and Royal Meteorological Societies.

OCEANOGRAPHY

The oceanographic program continues to be concerned with specific Navy needs in the areas of physical, biological, chemical and geological oceanography and in air-sea interaction phenomena. Broadening of the curriculum in late 1973 led to an extended multi-disciplinary approach. It also called for the development of new courses in maritime geophysics and basic hydrography to meet specific Navy requirements. The program as a whole continues to be attractive to young naval officers, with many more applicants than can be accepted. Three officers are currently enrolled in the doctoral program.

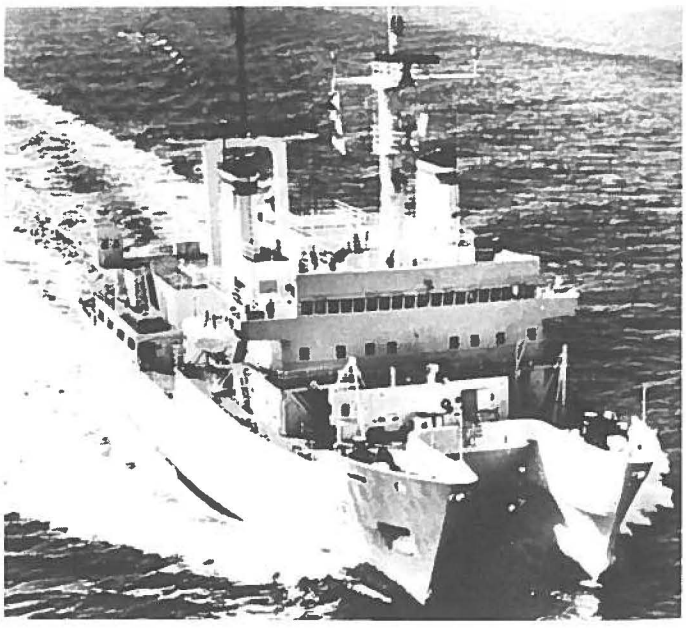
Of all sponsored research handled through the Department of Oceanography, the largest contract was with the Office of Naval Research, Ocean Sciences and Technology Division. It features sea-air interaction on scales from two meters to thousands of kilometers, and contains segments devoted to sound scattering and bio-deterioration. The Naval Air Systems Command provided funds for the study of marine fog. Other support came from the Earth Sciences Division of ONR for the study of kinetics of shallow water waves. The Arctic Submarine Laboratory sponsored research on thermal structures in the Arctic Ocean, while the Naval Ordnance Systems Command supported investigations leading to a treatise on ocean dynamics oriented toward naval applications. In addition to the sponsored research support, some funding was obtained through the Naval Postgraduate School Foundation and Fleet Numerical Weather Central.



Work at sea included 159 days on the NPS Research Vessel Acania; 16 days on the Naval Research Laboratory Ship Hayes in marine fog studies in the Galapagos area; 19 days on the Hayes for chemical oceanography studies in the Pacific; seven days on the AGOR Bartlett for geophysical and physical oceanographic observations; and 21 days on the USCGC Burton Island in the Chukchi Sea area.

Other field work included a polar oceanography class offered at Point Barrow, Alaska; ONR research conducted on the Navy off-shore tower at San Diego; and atmospheric turbulence research done on an AEC tower in Denmark.

Conferences organized or significantly influenced by faculty members included the Symposium on Prediction of Biological Sound Scattering in the Ocean from Physical and Chemical Parameters at NPS, sponsored by the Office of Naval Research and involving seven institutions; the Second Annual Conference on the Physics of Marine Fogs at NPS, sponsored by the Naval Air Systems Command and the Earth Sciences Division of the Office of Naval Research and involving representatives of 19 institutions; a workshop at NPS on shark research sponsored by the Office of Naval Research and the American Institute of Biological Sciences involving 34 institutions; a conference in San Francisco on Small Scale Sea-Air Interaction sponsored by the Ocean Sciences and Technology Division of the Office of Naval Research involving 18 institutions; a meeting of Department Alumni and associates in Washington, D.C. involving 60 officers; a meeting of Ocean Technologists at Asilomar, Pacific Grove, California involving 18 institutions; and the West Coast Regional Meeting, Oceanographic Division, of the American Geophysical Union in San Francisco, which included 89 scientific papers.



Naval Research Laboratory Ship HAYES

Seventy-two distinguished persons visited the department. These represented 18 naval activities, seven other academic institutions with oceanography programs, four foreign nations, and numerous other organizations concerned with the study of

oceanography. Two highlights were the site visits conducted by eight ONR representatives and the one-week visit by the two winners of the International Science Fair competition.

Dale F. Leipper, Ph.D.
University of California, Scripps Institution of Oceanography
Chairman,
Department of Oceanography

Professor Leipper was formerly Chairman of the Department of Oceanography at Texas A&M University. He has served as President of the American Society for Oceanography (1967-68), the American Society of Limnology and Oceanography (1957-58), and the Texas Academy of Science (1955). He has recently served as a member of the U.S. Committee for the International Hydrological Decade and the panel for International Marine Science Affairs of the National Academy of Sciences–National Research Council.

OPERATIONS RESEARCH AND ADMINISTRATIVE SCIENCES

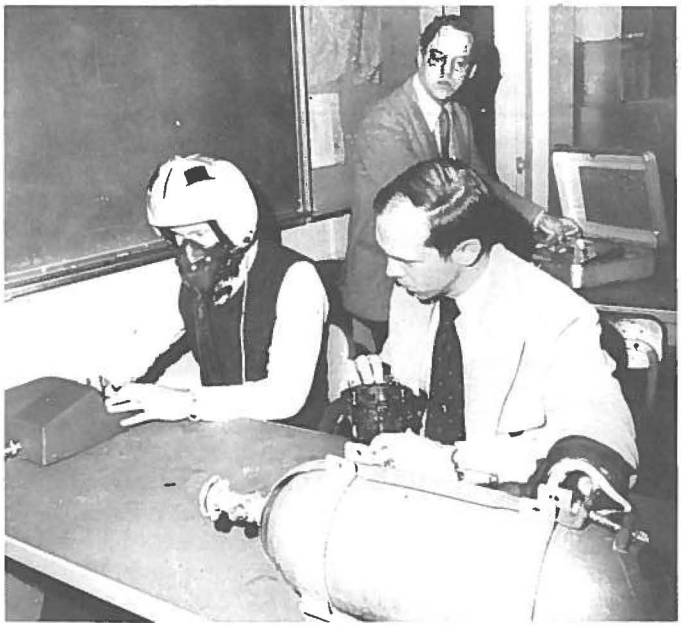
The Department of Operations Research and Administrative Sciences (OR/AS) continued to direct research in areas directly related to naval operations. Some of these projects included research in Navy Enlisted Manpower Modeling, Harbor Oil Spill Removal, Studies in Fleet Ballistic Missile Submarine Vulnerability and Impact of Inflation on Navy Stock Fund Management.

Members of the department have received recognition from various professional and educational societies. Professor Kneale Marshall was elected Chairman of the Western Section of the Operations Research Society of America (ORSA). He is also associate editor of *Operations Research,* the ORSA journal, and the journal of the Society for Industrial and Applied Mathematics. Professor D.A. Schrady was chairman of the ORSA Education Committee from 1971-74 and is now a member of the ORSA Resource Allocation Committee. He and Professor M.G. Sovereign are presently members of the board of directors of the Military Operations Research Society. Professor G.F. Lindsay is Chairman of the ORSA Military Applications Section.

The OR/AS department represents the largest academic unit within the Naval Postgraduate School. It is primarily responsible for curricula in Operations Research/Systems Analysis; Systems Acquisition Management; Administrative Science (Financial, Manpower/Personnel, or Material Management); Telecommunications Systems and Computer Systems. Additionally, the department is responsible for instruction in Human Goals/Human Resources Management pursuant to Navy and Department of Defense directives. All curricula, with the exception of Financial Management, were reviewed by the primary consultants during 1974.

The Telecommunications Systems curriculum saw further evolution and refinement in close cooperation with the Naval Telecommunications Command. A two-week experience tour, funded by that command, is being instituted in recognition of the need to continue productive communication experience with graduate education. The initial experience tours will be held at the Naval Communication Station, Stockton, California, and will include time aboard an aircraft carrier at Alameda.

The six-week experience tour within the Operations Research/Systems Analysis curriculum serves as a laboratory and internship for students in this program. Some experience tour locations are the Systems Analysis Division of OPNAV(OP-96), Naval Personnel Research and Development Center, Nuclear Aircraft Carrier Project Office, USA Operational Test and Evaluation Agency and VX-5. The doctoral program in Operations Research had six graduates during 1974, including one officer of the Federal German Navy. In March 1974, the first students graduated under the option program instituted within the OR/SA curriculum. The options, six in all, allow the student to develop specific professional expertise in systems analysis, tactical analysis, etc., through structured elective sequences.



The Computer Systems curriculum was refined further through the addition of a hands-on computing course and practical experience in the computer centers at NPS and at Fleet Numerical Weather Central, an NPS tenant command.

Support of student thesis research from Naval Material Command project offices was again strong for students in the Systems Acquisition Management curriculum, These theses were funded by several of the systems commands, Naval Electronics Laboratory Center, Naval Weapons Center, China Lake and

Commander, Operation Test and Evaluation Force. The Naval Postgraduate School was designated this year as the Navy's Procurement and Acquisition Research Center. This activity requires coordination between Headquarters, Naval Material Command, the Office of Naval Research and operating commands, and includes student and faculty participation.

Phase I of the Navy Human Goals Program was implemented through UPWARD seminars and the Phase II Human Goals implementation has evolved into a four-credit academic course in organizational development. Another major activity in this area has been the planning of a graduate-level program in Administrative Science (Human Resources Management) to satisfy the need for Human Resource Management specialists within the Navy and other services. Another innovation is the continuing liaison with Human Resource Management Centers in San Diego and Pearl Harbor. Professors D. Courtney, L. Darbyshire, M. Dean, B. Derr, C. Wright and R. McGonigal presented seminars at these centers. In a reciprocal act, visitors from the centers have periodically come to NPS to acquaint faculty and students with programs utilized by fleet activities in organizational development.

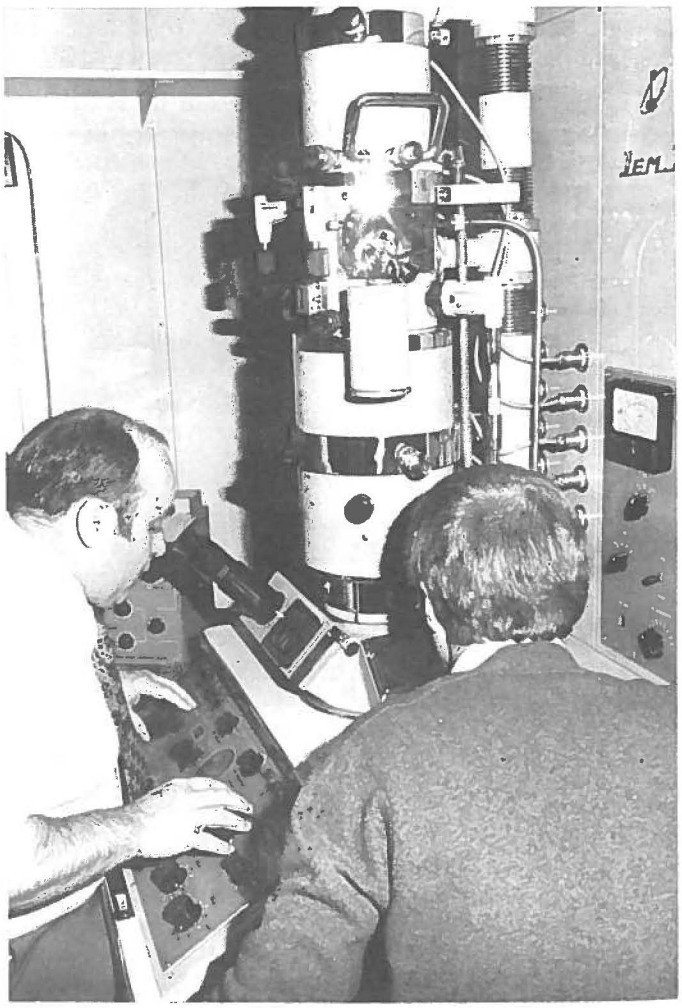
David A. Schrady, Ph.D.
Case Institute of Technology
Chairman, Department of Operations Research and Administrative Sciences

Professor Schrady joined the NPS faculty in 1965 and became chairman of the OR/AS department in April, 1974. He spent the academic year 1970-71 in the Operations Research Branch of the Mathematical and Information Sciences Division of the Office of Naval Research. He is a member of the Operations Research Society of America, a member of the ORSA Education Committee since 1967, and its chairman in 1971-74, and was 1970-72 Director of the Program of Visiting Lecturers in Operations Research. He is also a member of the Institute for Management Sciences, Tau Beta Pi and Sigma Xi.

PHYSICS AND CHEMISTRY

Research within the Department of Physics and Chemistry was highlighted by several noteworthy contributions. Professors A. Cooper and F. Schwirzke were honored for their work on laser-plasma interaction. Their efforts were rated one of ten most significant results in physics for 1973 by the American Physical Society. Professor R.L. Kelly's book, *Compilation of Atomic and Ionic Emission Lines Below 2000Å for Hydrogen Through Krypton* has been acclaimed within the scientific community as a definitive source book in spectroscopy. Laser beam propagation studies near the ocean-air interface continued to provide valuable data.

The department's Nuclear Physics group, strengthened by visiting Professor R. Pitthan from Darmstadt, Germany, realized outstanding results in its experiments on giant resonance oscillations of atomic nuclei. Their work was performed with the NPS linear accelerator. Cited for this work in *Physics 1974,* the group is currently the foremost organization functioning in this specialized area. Several student theses, in additon to 17 publications in scientific journals and presentations before scientific groups by Professors Pitthan, J.N. Dyer, F.R. Buskirk, E.B. Dally and X.R. Maruyama, resulted from this effort.



Research within the field of underwater acoustics included studies on the influence of physical and chemical fluctuations near the ocean's surface on sound propagation, finite amplitude waves, and the properties of ocean sediments. Professors W. Reese and D. E. Harrison worked on the physics of condensed matter. Professors W.M. Tolles and G.F. Schacher have cooperated with the Naval Weapons Center, China Lake, on fog and aerosol research.

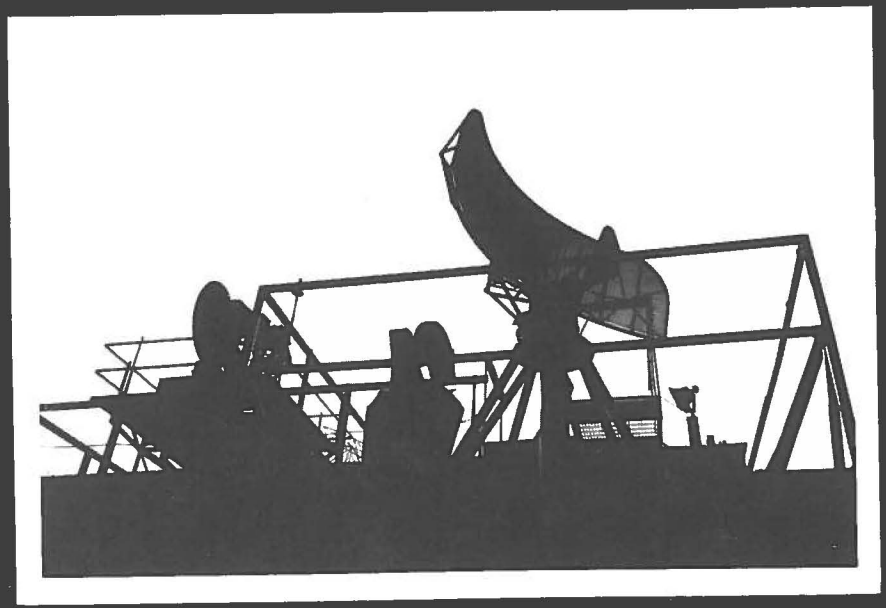
The department now serves as the major contributor to four technical curricula: Weapons Systems Technology, along with

its physics option, Underwater Acoustics and Anti-Submarine Warfare. In anticipation of the major role to be played by electro-optics and laser technology in future weapons development, new courses in radiation effects and lasers were developed. Six more new courses were introduced to meet the needs of the Weapon Systems Technology and three other courses were developed for the Underwater Acoustics curriculum.

Karlheinz E. Woehler, D.S.
University of Munich
Chairman, Department of Physics and Chemistry

Dr. Woehler came to NPS in 1962 and became chairman of his department in August 1974. Before coming to the United States from his native Germany, Dr. Woehler was employed by the Siemens & Halske AG of Munich as a research specialist, and later became a research associate at the Max-Planck Institute for Physics and Astrophysics. He has served as a consultant to North American Aviation, NASA and the Naval Electronics Laboratory Center. He is a member of the American Physical Society and Sigma Xi.

REPORT ON CURRICULAR OFFICES



ADMINISTRATIVE SCIENCE AND COMPUTER SCIENCE

The Administrative Science and Computer Science curricular office maintains eight different curricular programs: Computer Systems, Computer Science, Systems Acquisition Management, Administrative Science, and Administrative Science (Material), (Financial, Manpower/Personnel or Human Resources Management). More than 300 students from the four U.S. military services, the U.S. Coast Guard and about 20 allied countries receive supervision and counseling from this office.

During 1974, a major effort was devoted to reorganizing all curricula to identify preparatory and graduate phases and to insure that each incoming student enters at a level consistent with previous education. This has afforded each arriving student the opportunity to complete his program and qualify for the appropriate sub-specialty code and degree with in the minimum time commensurate with his previous educational experience.

Areas in the Administrative Sciences curriculum, which were formerly considered to be options (Material, Financial and Personnel Management), were classified as separate curricula. This action has allowed closer liaison with primary consultants to take place. The Fiscal Year 1976 Postgraduate School Selection Board, for the first time, selected students for direct input into these individual Administrative Science programs. In June, 1974, the first students were graduated from the new variable four-to-six quarter Administrative Science program, which includes the requirement for a master's thesis.

Development continues on the new Human Resources Management curriculum which is being designed around the core of the other Administrative Science curricula. The program will provide educational background and develop skills required by human resources management specialists. Introduction of this curriculum awaits final approval of the Navy's program.

As part of this overall program to improve curricula and maintain their currency with fleet programs, four curricular reviews were conducted. RADM Frank S. Haak, Director of OPNAV's Information Systems Division, reviewed the Computer Science and Computer Systems curricula in September. RADM R.J. Schneider, Commander, Navy Electronics Systems Command, reviewed the Systems Acquisition Management curriculum in February. The Administrative Science (Manpower/Personnel) curriculum was reviewed in November by Captain W.A. Lamm, Director of Officer Professional Development Division of the Bureau of Naval Personnel.

AERONAUTICAL ENGINEERING PROGRAMS

A comprehensive review of Aeronautical Engineering Programs was held in January 1974 by RADM N.O. Wittman, Vice Commander, Naval Air Systems Command. Several major actions resulted from that review, including recommendations for the development of a Doctor of Engineering program, programming of a few officers each year into the Dual Master's Program (to include Systems Acquisition Management), identification of approved professional development course sequences to supplement major areas of study defined by specialty areas, and restriction in the use of one-year non-degree study programs.

In September a letter was submitted to the Chief of Naval Personnel via the Chief of Naval Education and Training stating that Aeronautical Engineering programs were being modified so that officers could be received into these programs at any time, and requested BUPERS to order qualified officers in when available. For the first time, inputs were not constrained by the March and September starting dates. The first student received under this program reported in November.

To accommodate the variable entry dates of students, the preparatory program was restructured as follows: (1) the length

of the regular program was reduced to two quarters, each being independent of the other; (2) courses are being packaged in the self-study format so that students can proceed at their own pace which, in some cases, will be faster than normally experienced in classroom programs; (3) courses are being repackaged into mini-courses which will be normally one credit hour in length.

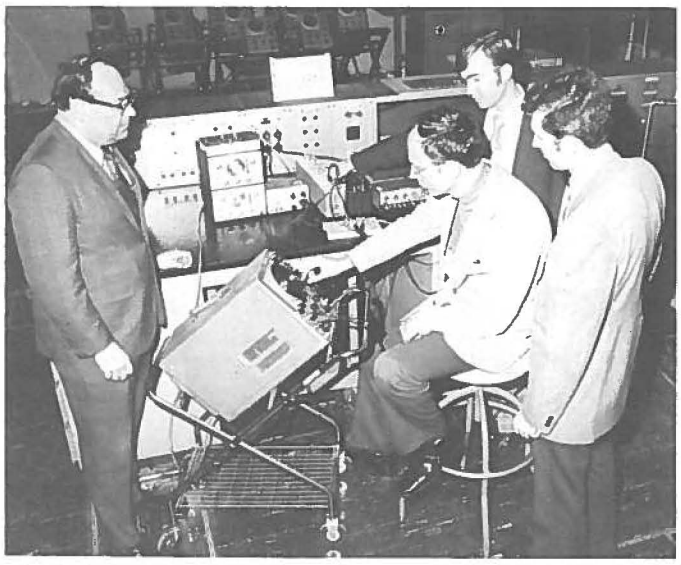
On December 4, a program review was conducted by VADM Kent L. Lee, Commander, Naval Air Systems Command. The continuing requirement to provide officers in Aeronautical Engineering programs with a strong technical background was stressed at this meeting.

ELECTRONICS AND COMMUNICATIONS ENGINEERING PROGRAMS

The three graduate educational curricula of the Electronics and Communications Programs have kept pace with a changing Navy. In addition to the requirement for a sound technical and scientific education, an additional requirement is recognized for general knowledge of the financial aspects of the material procurement process. All programs have been broadened to include these related studies.

A detailed review of the Telecommunications Systems curriculum was conducted by the sponsor, RADM Jon L. Boyes, Commander, Naval Telecommunications Command. The results of this examination were incorporated into realignment of courses in several areas, which included about one-fourth of the curriculum. Two examples of this change are to be found in the Navy and Defense Telecommunications series and a Technology of Communications sequence. Plans have been made to include an experience tour for students for the purpose of providing functional indoctrination at a modern military telecommunications activity. The first of these tours was conducted in February 1975.

There has been a marked increase in the degree of preparation of incoming students with respect to their curriculum. More than half of the arriving Navy students had undergraduate degrees in electrical engineering. Likewise, the average length of time between completion of undergraduate studies and entry into NPS programs has decreased, a period of five years being the common interval. Actions have been initiated to take full advantage of these improvements in student qualifications through accelerating parts of the program. Comprehensive review courses were designed to cover in one quarter the material normally taught to non-electrical engineering undergraduate students through a two to three-quarter program of study. Areas condensed are: circuit theory, electromagnetics and electronics circuit engineering. The accelerated student is able to complete an equivalent graduate program in six to nine months less time than previously required. The program continues to be broad-based and flexible, permitting the student to develop in his area of interest.



The U.S. Navy officer student input into Electronics and Communications Engineering curricula has decreased by about 20% over the last year. Other student sources have remained constant.

The current officer population which entered the Telecommunications Systems curriculum in 1974 represented all warfare communities of the Navy, including several officers from special duty cryptology. Many of these students have had experience in operational naval communications.

The Telecommunications Systems curriculum is now available to international students. The first international student is expected to enter this program in 1975.

Graduates were ordered to a wide variety of operational and technical/managerial duty assignments. Several were ordered to command at sea and others to professional schools, such as the Destroyer School Department Head Course, and service colleges. Many were assigned to systems command project manager directorates and other headquarters level assignments. Of those U.S. Navy officers graduated from these programs in 1974, 35 were ordered to immediate "pay back" tours, 27 to fleet billets and 15 to professional schools (mainly Navy Destroyer School) leading to fleet assignments.

UNDERWATER ACOUSTICS

Two recent events of major importance for the Underwater Acoustics curriculum were the annual review and the Navy Underwater Acoustics Symposium sponsored by the Underwater Acoustics Branch of ONR.

The annual review was conducted in April 1974, with Captain John R. Balis of Naval Ship Systems Command and Captain Reynolds Beckwith of Naval Electronics Command as

senior sponsor representatives. As a result of the review, action has been taken to improve the balance of the curriculum. Some courses have been consolidated, and the Electrical Engineering graduate sequence is being redesigned with more emphasis on acoustic signal processing. The board recommended that modest funding be provided by the consultants to encourage necessary travel for thesis research and seminar speaker support. Funding was later provided by the new Naval Sea Systems Command. As a result of the recommendation, part of these funds were used to finance student and faculty participation in the bi-annual Navy Symposium on Underwater Acoustics in November in Washington, D.C. The symposium provided significant benefits to those attending and future participation is planned.

In addition to an active guest lecture/seminar program dealing with acoustics, ASW and underwater weapons, students visited the Naval Facility, Point Sur, California, the Tactical Support Center at Moffett Field and the Naval Undersea Center, San Diego. The trips provided an insight into operational problems and acquainted students with development in acoustics systems.

Ten officers were graduated in December. Six returned to sea duty and the remainder went to billets in which they can immediately utilize their newly acquired acoustics expertise, e.g. in the Underwater Acoustics Branch of ONR. Six students are scheduled to graduate in December 1975. A new class of 12 students commenced the program in September. There are six international officers in the curriculum. For these officers, substitute material is programmed in place of the classified portion of the curriculum. 1974 also saw the matriculation of the first woman officer in the program.

ENVIRONMENTAL SCIENCES

The Environmental Sciences Curricular Office administers the Oceanography and Meteorology programs.

Fifty-five officers were graduated from the two programs, receiving master of science degrees. Three of the oceanography graduates had completed the Immediate Graduate Education Program of four quarters of graduate education immediately following their undergraduate studies.

This is the year in which oceanography students have been fully involved with the revised oceanography curriculum initiated in September 1973, when the program was broadened to include work from at least five academic departments. The number of individual courses was limited to four each quarter. A strong acoustics-in-the-sea sequence was introduced to run throughout the curriculum. The amount of underwater physics was increased and the amount of electrical engineering tripled, with continuing emphasis on air-sea interaction. Provision was made for field experience tours, as well.

The curriculum modifications introduced were based upon an in-depth series of investigations of Navy needs. These investigations included conferences with the sponsors, consideration of the Delphi studies results, meetings and correspondence with alumni and several detailed investigations in the form of thesis studies.

In meteorology, a typical graduate program for a student without previous education in meteorology consists of eight quarters. A review of this curriculum was conducted by the primary sponsor, Commander, Naval Weather Service Command, in April at NPS. It was determined that the curriculum meets the current and projected needs of the Navy for graduate education of Navy meteorology specialists and sub-specialists, with only minor modification to the existing courses being recommended.

NAVAL ENGINEERING PROGRAM

The Ship Engineering Education Committee, headed by RADM K.E. Wilson of the Naval Sea Systems Command, conducted the annual sponsor's review of the Naval Engineering Program during January 1974. The major recommendation that the committee made was that the Dual Program in Naval Engineering and Management be reduced in length from a nominal 15 quarters to a 12-quarter program.

This recommendation has been implemented by integrating course material of the engineering and project management programs. The first group of students are enrolled in this program, which will result in their fulfilling the requirements for subspecialty coding in both ship engineering and management in a total of 12 quarters.

Twenty-six students were graduated from the Naval Engineering Program in 1974. Of these, four were international officers who returned to their native countries where their technical education will be utilized in improving operation of shipyards, aboard ships in engineering billets and in teaching technical subjects at service academies. Of the 22 U.S. officers who were graduated from the program, eight were ordered to ships, seven to engineering billets and one to command. The remainder were ordered to billets ashore in shipyards, to force staffs, to command and to teaching midshipmen.

Emphasis upon Navy-related student research has resulted in a concentration of student research efforts within the following areas:

Heat transfer–(1) cooling of closely packed solid state electronic modules used in radar and communications equipment; (2) natural heating and cooling of bombs and missiles in open dump ammunition storage.

Materials science–(1) high damping metals for use in silencing surface ships and submarines; (2) shape memory alloys for use in securing high performance gun barrel liners and joining high strength aircraft tubing; (3) strength and fatigue characteristics of composite materials such as ferrocement used in building boat hulls.

Hydromechanics–(1) fluidic control and sensing systems for use in ships, aircraft and tanks; (2) wave and flow induced forces on submerged and semi-submerged bodies, such as submarines and ship hulls, spars and buoys; (3) hydrodynamic characteristics of a liquid propellant gun system.

NAVAL INTELLIGENCE

The Naval Intelligence curriculum, which received its first group of 24 students in September 1973, has continued to grow and develop into a valuable educational resource. Eight new courses, developed especially for this curriculum, were taught for the first time. Four of these new courses in engineering subjects stress a wholly new, non-mathematical approach to the technological aspects of naval intelligence. Another of the new courses concerns itself with the growth and capabilities of the Soviet Navy.

Innovative approaches to meet the challenges which face the curriculum were introduced with noted success. Cancellation of mathematics refresher courses posed serious problems for incoming students who had weak to nonexistent mathematical backgrounds. On the other hand, experience with the first group indicates that a stronger mathematical preparation for the engineering courses (including Fourier analysis and LaPlace transforms) is desirable. An experimental course was developed and taught, which reviewed college algebra and taught in one quarter those elements of calculus, Fourier analysis and LaPlace transforms essential for use in subsequent technical courses. This appears to have been a greater success than initially anticipated. In September, the second group of 20 students was received. These students represented every unrestricted line warfare specialty.

The capability of the Naval Postgraduate School to meet the Naval Intelligence Command's educational requriements was significantly enhanced by the completion of a Special Intelligence (SI) facility. The 1083-square-foot facility, consisting of a classroom and storage area, provides the necessary physical security to introduce extremely sensitive information into the curriculum. It provides a combined classroom, research area, reading room, and library for use by all appropriately cleared personnel at the school. One of the primary benefits of the facility is that it allows visiting lecturers from the intelligence community to discuss classified material without undue restraints. It was most appropriate that the first speaker to use the facility was the Director of Naval Intelligence, RADM Bobby R. Inman.

RADM Inman's visit was part of a vigorous, continuing program of Naval Intelligence Seminars. In the last calendar year, 27 seminars were conducted, 15 of which were delivered by visiting lecturers. The seminars supplement the academic portions of the curriculum by introducing the students to specific issues and challenges faced by the intelligence community. One of the most successful seminars was conducted by RADM Edwin T. Layton, USN Ret., the first 1630 flag officer and one-time intelligence officer to FADM Chester W. Nimitz. Other seminar speakers were RADM Samuel B. Frankel, USN Ret., first Chief of Staff, Defense Intelligence Agency and Captain Wyman H. Packard, USN Ret., former Deputy Director of Naval Intelligence. The speakers addressed a variety of subjects designed to give the students an historical perspective of their chosen sub-specialty.

The degree of cooperation and mutual support between NPS and the Naval Intelligence Command is very high. NAVINTCOM provided support for student and faculty research on related intelligence problems, which directly benefited all participants NAVINTCOM provided Special Intelligence files and a miniaturized data base to the school to support course development work and research projects. The students have undertaken thesis research on many of the topics suggested by NAVINTCOM. Faculty trips to Washington, D.C. to explore new research possibilities were supported by both NPS and NAVINTCOM. These relationships provide a valuable additional resource and an increased intelligence education capability to the Naval Intelligence curriculum.

OPERATIONS RESEARCH/SYSTEMS ANALYSIS PROGRAM

In the Operations Research/Systems Analysis (OR/SA) Option of the curriculum, each student entering the advanced phase selects an area of academic emphasis or specialization in recognition of requirements of his particular military service and personal interests. The options available for selection by the student are systems analysis, operations evaluation (Navy or Marine Corps/Army), logistics, human factors, and advanced modeling.

There were several notable contributions to the military services by students through theses and experience tours. The first foreign student to receive the Ph.D. in operations research at NPS, CDR Harald Ziehms, Federal German Navy, was graduated in December. Major Robert Demont and Captain Thomas White, U.S. Army, completed a joint thesis which constitutes a superior analysis of tank battle damage data collected during the Yom Kipper War in the Middle East. During an experience tour at NAVSEA PMS 392, LCDR David H. Vigrass, USN, developed a computer model which is currently being used to forecast overhead costs for the CVN-70 aircraft carrier construction program. The Defense Contract Auditing Agency at Newport News has expressed interest in incorporating the same model into its projection program for overhead costs.

Meanwhile, Captain Richard C. Adkins, U.S. Army, developed the conceptual test design for the STINGER Man Portable Air Defense System Operational Test II while employed at the Army's Operational Test and Evaluation Agency, Ft. Belvoir, Virginia, during his experience tour. The results of work by LCDR Paul R. Bosworth, USN, in a November-December 1973 experience tour at Oakland Naval Supply Center were commended in May of 1974 by the commanding officer of that activity. Most of LCDR Bosworth's study recommendations were implemented and yielded improved efficiency of operations and a reduction of pre-purchasing time (for non-aviation issue Group II and III demands under $100) from 18 days to seven days.

ANTI-SUBMARINE WARFARE

The new Anti-Submarine Warfare (ASW) curriculum continues to provide operationally-oriented graduate education for officers of all ASW communities. 1973 saw the initial group of 21 officers enter the program, while the second class of 27 officers entered the program in March 1974. The second group is composed of 13 surface officers, 10 aviators and four submariners. The interaction of officers from the various experience levels continues to be a highly beneficial element in strengthening the program.

In March, the initial group presented seven excellent group projects in which particular ocean areas were analyzed to determine the optimum mix of ASW systems for each area. The variables of operational effectiveness and cost feasibility were emphasized in the study. These reports generated significant interest throughout the Navy.

An active seminar series has continued to augment the program by providing operational and technical briefings and discussions with senior naval officers and civilian experts from the ASW community. Some of the guest speakers were Admiral Elmo Zumwalt, RADM M. Staser Holcomb, RADM S.M. Cooley and a number of intelligence briefers. In further efforts to maintain fleet orientation and the real-world flavor in the program, the students and faculty visited local naval facilities and various agencies and commands in San Diego during the year. They also visited units of the destroyer force during Monterey port visits of the destroyers Gridley, Brooke, Buchanan, Wiltsie and Epperson.

Several minor adjustments were made in the curriculum as a result of experience with the lead class and from cooperative weekly evaluation and coordination sessions between the curricular officer and the ASW Academic Group. In October, an extensive curriculum review was conducted by Captain Wayne Hughes, OP-96B, representing the program consultant, and senior representatives of operational air, submarine, surface and surveillance commands. The board was favorably impressed with the curriculum and with the enthusiasm and motivation of the students and faculty. Recognizing manpower management dichotomy in the assignment/detailing system, the board recommended that the ASW program be removed from the P-code system and that the Bureau of Naval Personnel identify additional billets that could advantageously be filled by graduates of the program.

As the year closed, the first section of students was completing the curriculum by working on theses and group projects. These activities interfaced with several of the academic disciplines that comprise the curriculum. Included are acoustics, signal processing, operations analysis, human factors, environmental science and non-acoustic sensors. Eight of these officers are developing short courses which could be presented at ASW operational commands. These first ASW officers have received their orders and will be assigned operational billets in which their newly developed ASW expertise will be utilized.

WEAPONS ENGINEERING PROGRAMS

There have been many changes in the Weapons Engineering curriculum that include . . .

- A change in the title of the curriculum from Ordnance Engineering to Weapons Engineering.

The new title provides a better description of the nature of the available programs. There was also a change in the name of the subspecialty consultant, now the Naval Sea Systems Command (formed by a merger of the Ordnance Systems Command with the Naval Ship Systems Command).

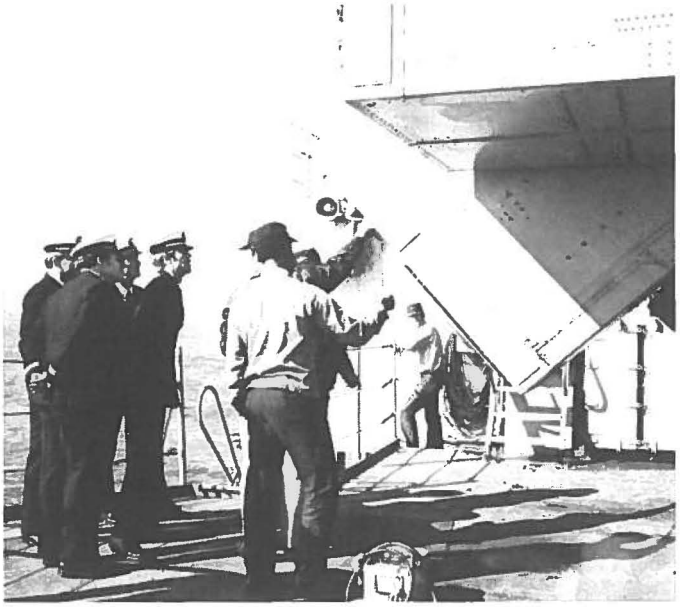
- A new curriculum option entitled Weapon Systems Technology.

This new curriculum was designed to produce an officer with a broad-based technical education emphasizing the concepts of systems engineering. Applications to current weapons systems are stressed. Computer science, electrical engineering and technology of explosives are important components of the program, which has been reviewed and endorsed by the sub-specialty consultant. The first class of students began work in September.

- Major updating/modernizing of the Electro-Optics/Laser Technology option.

In March and September, sponsor reviews of the Weapons Systems Curriculum options were conducted in Washington, D.C. by a committee headed by RADMs Roger Spreen and Stan Counts. An in-house review of the Electro-Optics/Laser Technology option was conducted at NPS in May at the request of the Naval Ordnance Systems Command, co-chaired by CDR R. W. Hine and Professor John Dyer. The most significant result of the reviews was a modification in the Electro-Optics/Laser Technology option. The major thrust is now toward the rapidly emerging field of electro-optics and lasers, with greater emphasis on systems concepts and applications.

- The renewal of an active seminar program.
- An active seminar program featuring speakers from operational and system commands has been made an important part of all Weapons Engineering programs. "If you cannot bring the student to the experience, bring the experience to the student," is the current thrust. Some outstanding speakers in the program were RADM Mark Woods, COMCRUDESPAC; Captain W.E. Meyer, PROJMAN SMS; Captain C.E. Seeger, NAVSEASYSCOM; and J.F. Higgins, of the Naval Ship Missile Systems Engineering Station.
- The establishment of faculty familiarization/indoctrination trips to naval activities.
- NPS-sponsored ship visits to Monterey Bay for faculty and student familiarization and indoctrination.
- Increased emphasis on relevancy in academic curricula.



Indoctrination of faculty in current and future weapon systems has been initiated with fourteen faculty members from various disciplines attending a week-long course at the Combat Systems School in Vallejo, California, and a week-long indoctrination aboard ships and at various naval activities in San Diego. This program will continue in the future because of the enthusiastic reception by participating faculty. Included in this program is active endorsement of ship visits to Monterey. During the past year, five different classes of ships visited here, hosting faculty and students on board for indoctrination familiarization.

In addition to the foregoing, some outstanding student research, having to do with various aspects of the MK-86 gunfire control system, developed into theses. There was also an important study on the disposal of excess and waste explosives. Most of the students, upon graduation, were assigned to duty at sea. One graduate went to a billet in the Naval Electronics Systems Command.

BACCALAUREATE PROGRAMS

The year 1974 began with the disappointing news that Congress has directed the Navy to discontinue its undergraduate program at the Naval Postgraduate School. Termination of this program will occur by June 30, 1975. Students already in the program will complete their studies.

CURRICULAR OFFICERS

Leroy R. Bechelmayr, Commander, U.S. Navy
M.S., Naval Postgraduate School
Curricular Officer, Environmental Sciences Programs

A graduate of the Naval War College, CDR Bechelmayr has served as Executive Officer of Fleet Numerical Weather Central and with the Naval Material Command in Washington, D.C. He has also served in USS PHILIPPINE SEA (CVS-47) and on the staff of the Commander, Amphibious Group Three as a meteorologist. CDR Bechelmayr was a faculty member in the Department of Meteorology at NPS from 1961-63, and rejoined the faculty of the Department of Oceanography at NPS in 1972.

Philip F. Carothers, Jr., Captain, U.S. Navy
M.S., Naval Postgraduate School
Curricular Officer, Naval Engineering Programs

Captain Carothers was Plans and Policy Officer in the Pacific Fleet Maintenance Staff of the Seventh Fleet, where he served as an adviser to the Vietnamese Navy. Earlier he served as Repair Officer to the Yokosuka Naval Ship Repair Facility. He was also an Assistant Repair Superintendent and Project Officer for conversion of USS ALBANY from a conventional heavy cruiser to a guided missile cruiser.

Robert W. Chapin, Jr., Lieutenant Commander, U.S. Navy
M.S., Naval Postgraduate School
Curricular Officer, Naval Intelligence Curriculum

LCDR Chapin first served as an officer agent and assistant branch head in the Ninth Naval District Intelligence Office. Following a tour in South Vietnam as an intelligence advisor, he served as an Intelligence Plot Watch Officer in OPNAV. LCDR Chapin has served as an assistant Intelligence Officer on the staff of COMPHIBGRU ONE. A succession of short tours in OPNAV, Attache School and French Language training was followed by a two-year tour in the Bureau of Naval Personnel. In his last operational billet, LCDR Chapin was the Force Intelligence Officer, COMIDEASTFOR in Bahrain.

Joseph H. Cyr, Lieutenant Commander, U.S. Navy
M.S., Naval Postgraduate School
Curricular Officer, Operations Research/Systems

LCDR Cyr was part of the commissioning detail for the USS JOHN KING (DDG-3) and then was assigned as an instructor in Naval Tactical Data Systems at the Fleet Anti-Air Warfare Training Center at Dam Neck, Virginia. He was operations officer of the USS KING (DLG-10) and, later, reported to the staff of the Commander, U.S. Naval Forces, Vietnam, where he served as an operations analyst. In his most recent operational assignment, he was Executive Officer of the USS NOA (DD-841).

Windom L. Estes, Commander, U.S. Navy
M.S., Naval Postgraduate School
Curricular Officer, Management and Computer Science

A naval aviator who has served in carrier-based squadrons, CDR Estes also served with the Joint Staff in Washington, D.C. and on the staff of Commander, Attack Carrier Striking Force, Seventh Fleet in Vietnam. Another tour in Vietnam included service with the staff of the Commander, Cruiser-Destroyer Group, Seventh Fleet.

Donald T. Fitzgerald, Commander, U.S. Navy
B.S., University of Utah
Curricular Officer, Baccalaureate Programs

CDR Fitzgerald is a naval aviator whose naval service has included assignments in various multi-engined patrol and photo-reconnaissance squadrons. He has also served as the Aircraft Maintenance Officer aboard USS BENNINGTON (CVS-20), as a basic flight instructor; as legal and administrative officer of Naval Air Station, Brunswick, Maine. Other assignments include Commanding Officer of Flag Administrative Unit, Quonset Point, Rhode Island and Commanding Officer of Enlisted Personnel at NPS.

Raymond W. Hine, Commander, U.S. Navy
M.S., Naval Postgraduate School
Curricular Officer, Physical Science and Operational Systems Technology Programs

A 1955 Naval Academy graduate, CDR Hine has had extensive experience in sea billets. He has commanded the destroyers USS JAMES C. OWENS (DD-776) and USS ORLECK (DD-886). He has served, as well, on the destroyers DORTCH and GYATT and the cruisers GALVESTON and LITTLE ROCK. During a tour of duty in Washington, D.C. he served as a program manager in the Naval Ordnance Systems Command associated with the development of surface-launched guided missile systems.

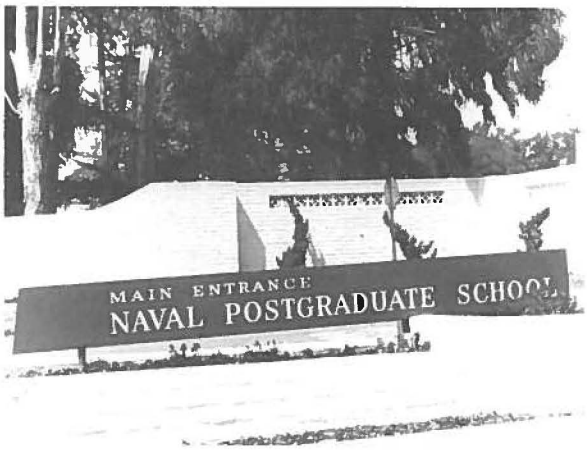
James B. Poland, Commander, U.S. Navy
M.S., Naval Postgraduate School
Curricular Officer, Aeronautical Engineering Programs

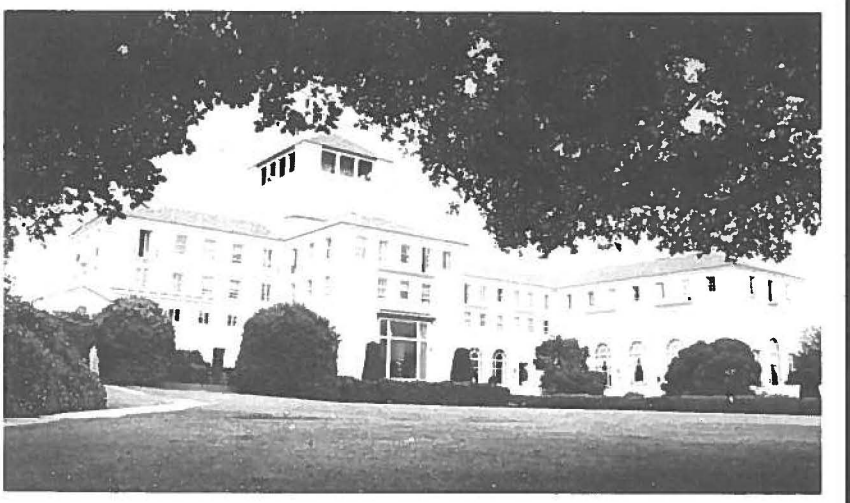
A naval aviator with extensive aviation operational experience, CDR Poland has served as Staff Plans Officer on the staff of Commander, Fleet Air Wings Pacific. Other assignments include duty aboard USS YORKTOWN as First Lieutenant and as tactics officer and maintenance control officer of Patrol Squadron 40 at Naval Station Sangley Point. CDR Poland was an instructor in the Engineering Department at the Naval Academy and later assumed duties as Co-Chairman of the Aerospace Engineering Department.

Peter S. Roder, Commander, U.S. Navy
M.S., Naval Postgraduate School
Curricular Officer, Electronics and Communications Programs

Formerly the Commanding Officer of USS SOUTHERLAND (DD-743), CDR Roder has also served as Executive Officer of the USS O'CALLAHAN (DE-1051) and the USS COOK (APD-130). Other duties include assignments with the U.S. Naval Communications Station, Cam Ranh Bay, Vietnam, and with the Pacific Staff of the Operational Test and Evaluation Force, where he served under the Deputy Commander as Head, Communications Systems Test and Evaluation Section of the Command and Control Systems Division.

OTHER ACADEMIC PROGRAMS AND SERVICES





AVIATION SAFETY PROGRAMS

Three-hundred-seventy-four Aviation Safety Officers (ASO) were educated in NPS Aviation Safety Programs in 1974. This number included 85 Marine Corps aviators, 33 Naval Flight Officers (NFO), seven USMC NFOs, two civilians and one Navy Medical Corps Officer. Of the remainder, 234 were U.S. Navy pilots and ten graduates were from allied nations. The four-week curriculum, entitled *Survey of Aviation Safety (SAS)*, covered aeronautical engineering, accident prevention and investigation, aviation phychology, physiology and law. In addition, the Aviation Safety Programs presented similar aviation safety courses to 40 resident NPS students, 28 from the Baccalaureate Program and 12 from the Aeronautical Engineering Program.

The importance of safety education was underscored by representatives of the Chief of Naval Operations through a directive issued to the Chief of Naval Education and Training and NPS, which initiated a study of feasibility and funding requirements for inclusion of system safety engineering in curricula of appropriate master's level engineering courses. It was determined that scientific methodology for identification and elimination of hardware safety design defects should be part of the education of postgraduate engineering students, because a large proportion of safety problems in naval aircraft, ships and weapons originate in design deficiencies.

This same directive also modified the short program for the fleet. The SAS course was replaced by a six-week Aviation Safety Officer (ASO) course. The expanded course covers systems safety, the Occupational Safety and Health Act (OSHA), industrial safety and shipboard safety. It allows the students more time to assimilate subject matter, conduct practice accident investigations and write complete aircraft accident reports. Another new course was instituted to provide safety education to Staff Safety Officers who have had ASO experience at the squadron level. This Advanced Safety Management course is of four weeks duration.

To enhance the new ASO course, an agreement has been made with the NPS Department of Aeronautics to use the slow speed wind tunnel, the smoke tunnel and the structural testing machines. Also, a parcel of land adjacent to Fritzsche Army Airfield at Ft. Ord has been made available by the Army for the Navy's use as a crash investigation laboratory. These ten acres of land will allow several aircraft accidents to be reconstructed to actual scale. Current inventory of wreckage includes CH-46F, A-7A and T-2C aircraft . . . plus bits and pieces of other models.

Clyde H. Tuomela
Captain, U.S. Navy
M.S., George Washington University
Director, Aviation Safety Programs

Captain Tuomela is a Navy test pilot and a 1971 graduate of the Navy War College. He came to NPS from the Naval Air Systems Command, where he was deputy Project Manager of the F-14 Test and Evaluation Program.

CONTINUING EDUCATION PROGRAMS

The Office of Continuing Education was established on June 1, 1974. It functions to plan, conduct and administer programs of extended educational services to help reduce the average length of fully-funded graduate education tours, enhance the Navy's timely utilization of advancing knowledge, and provide educational counseling to the Navy officer corps.

Future plans call for the development of short courses to provide technical review for officers who have been inactive in their sub-specialty areas for several years. Other short courses are being developed to meet specially stated requirements for advanced professional education. These courses will be delivered both on and off campus. Those taught off campus will be available in both the lecture and self-instructional tutor-assisted modes. To assist these efforts, qualified officers with related graduate education will serve voluntarily as tutors in the self-instructional courses and will receive written recognition for this effort from the Superintendent.

The program is underway at this time. During the calendar year of 1974, six courses were delivered under the auspices of the Office of Continuing Education. Ten additional self-instructional tutor-assisted courses are in the initial stages of development and, when completed, will be delivered to officers at their current duty stations upon request. Additional short courses are in the initial stages of development.

W. Max Woods, Ph.D.
Stanford University
Executive Director, Office of Continuing Education and Dean of Educational Development

Dr. Woods was formerly Chairman of the Department of Mathematics. He is a member of the Institute of Mathematical Statistics, American Statistical Association, Operations Research Society of America, American Society of Engineering Education and Sigma Xi.

DEFENSE RESOURCES MANAGEMENT EDUCATION CENTER

The Defense Resources Management Education Center serves the purpose of fulfilling the Department of Defense requirements for educating high-level military and civilian personnel working in planning, programming, budgeting, systems analysis or resource management activities of the Department of Defense components in the Office of the Secretary of Defense, Departmental or Agency Headquarters, and selected commands. The Center conducts U.S. and international courses for individual governments at overseas locations. Lectures and presentations by recognized managers are followed by group discussions, group and individualized problem solving to apply the material to realistic military issues. Study and reading of current publications round out the programs. Interdisciplinary teaching provides students with a comprehensive and current understanding of national and international resources management, associated problems, and demonstrated sessions to apply their education to related problem solving.

During the past year, the Defense Resources Management Education Center has conducted 22 courses for 1051 participants . . .

- Eight four-week Defense Management Systems Courses and two one-week Flag/General Defense Management Systems Courses were held in Monterey.

- Two one-week Navy Activity Management Courses and four two-week Navy Advanced Management Courses were conducted off-campus for 210 participants. The one-week courses were held for Commander, Fleet Air Wing, U.S. Pacific Fleet, Naval Air Station Moffett Field; and Defense Contract Administration Services Region, San Francisco at Burlingame. Two-week courses were held for Naval Air Station Jacksonville; Pacific Missile Range, Pt. Mugu; Chief of Naval Education and Training; and the Command Naval Ship Missile Systems Engineering Station, Pt. Hueneme.

- The 13-week International Defense Management Course was conducted twice at Monterey. The participants were well chosen, industrious and responsive. The program provides the basis for increased knowledge of resource management and the nations involved, and insures understanding through newly developed friendships that are international in flavor.

- The four-week Senior International Defense Management Course for Flag/General officers and senior defense officials was for the fifth time in Monterey for 41 participants from 16 nations. Included were Argentina, Germany, Honduras, Indonesia, Iran, Israel, Jordan, Liberia, Pakistan, Peru, Singapore, Spain, Thailand, Turkey, Venezuela and Vietnam. Argentina, Honduras and Liberia were represented for the first time.

- Mobile Training Teams from DRMEC were furnished to Vietnam, Thailand and Indonesia. There were 399 individuals from those nations enrolled in the program.

- In July, a program was conducted in Monterey for twelve prospective faculty members of an Indonesian Management Systems Center, called LEMBAGA. Three months prior to that time, preparatory instruction was given and materials provided for this intensive study and curriculum development.

LEMBAGA was dedicated and opened on October 28. Its first course offering was for 53 Indonesian Flag/General officers. The course was given with the assistance of a faculty team from DRMEC. The second course was delivered by the Indonesian faculty members with assistance of two DRMEC faculty. This same assistance will be given for two courses in calendar year 1975.

- Since the Defense Resources Management Education Center was established in September 1965, 178 courses have been held for 8143 officers and civilians of U.S. and allied nations.

Paul Ecker, Ph.D.
Claremont College
Chairman and Executive Director, Defense Resources Management Education Center

Dr. Ecker became the Chairman and Executive Director of the, then, Navy Management Systems Center in 1965. He is the author of several articles and co-author of *Handbook for Supervisors,* published by Prentice-Hall, Inc. He is a member of the Academy of Management, the American Economic Association, and the Commonwealth club of San Francisco.

RESEARCH

Research marks the highlight of the academic experience for students as they enter into real time problem solving and have the opportunity to bring their newly acquired education to bear upon the process. Faculty also continue to update their abilities through continued research and support of student thesis projects. Numerous research projects which are directly related to military problems are currently ongoing and receive most enthusiastic support from sponsors within the Navy. A brief sampling of these studies includes: Computation of Sound Propagation in the Ocean; Research on Law of the Sea; Development of a Computer Controlled "No Drop Bomb System;" Assistance in Design and Analysis of New Arresting Gear Engines (Naval Air Engineering Center); Materials with Memory; development of Climatology Charts for the North Atlantic; Study of Air-Sea Interaction and Effect Upon Acoustic Range; and Studies of Laser Transmission in the Marine Environment. Four of these studies are explained in more detail at the end of this section.

From a management point of view, the present research program can be divided into two separate parts: the *Foundation Research Program,* which is akin to institutional research programs in civilian universities or independent research programs in government laboratories and contractor organizations; and the *Sponsored Research Program,* which is similar to the contract research done by civilian universities, government laboratories and defense contractors.

Research at NPS was supported by 26 sponsors during fiscal year 1974 and 37 during the first half of fiscal year 1975. Funding from the sponsors for the fiscal year 1974 research program was $3.3 million and for fiscal year 1975, $2.9 million. Actual funds expended in calendar year 1974 approximated $3.0 million.

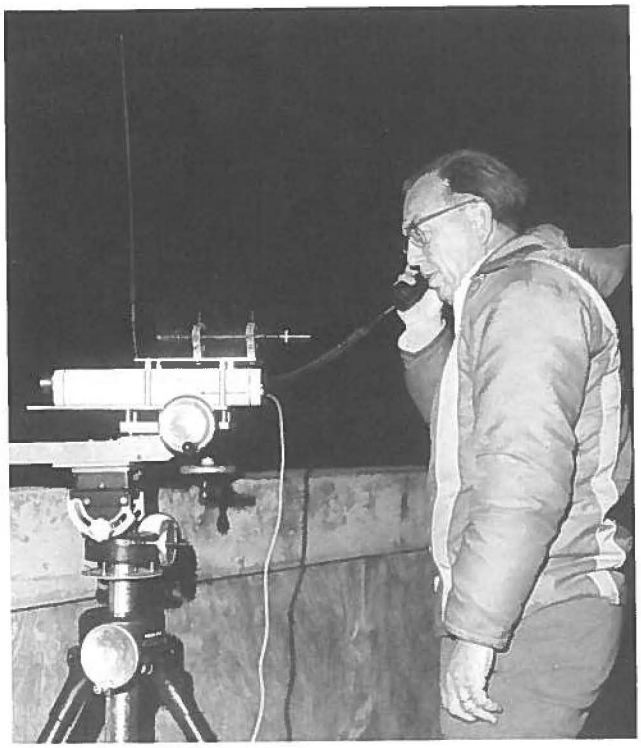
The NPS program has several characteristic features which distinguish it from civilian university research programs. First is the emphasis on Navy-related programs. This emphasis is due less to statutory limitations, than to student and faculty interest. Most students come to NPS with six or more years of operating experience with the fleet, bringing with them great interest in military problems. Those interests motivate them to seek research opportunities in their graduate studies. Additionally, many faculty members have long-term close ties with Navy laboratories and Systems Command activities. Secondly, most of the students are working toward a master's degree rather than the doctorate. However, these are not ordinary graduate students, fresh from baccalaureate studies. As noted above, their fleet operating experience has provided them with deep practical insights which contribute to the solution of thesis problems they have chosen. Finally, the research sponsoring organizations have found that the NPS program provides an economical and meaningful supplement to their own research efforts. Contributing to this is the broad background found across the academic departments. This results in competence at NPS in the application of the academic disciplines toward the solution of multi-disciplinary and systems problems.

This latter characteristic of research at NPS is evidenced in the school's preeminence in such areas as underwater acoustics, turbo-machinery, fluid dynamics, oceanographic and meteorological prediction, and operations research. The continued thrust toward multi-disciplinary excellence is further evidenced by emerging research foci in the technology of anti-submarine warfare, naval gunnery, electro-optics and lasers, and signal detection and classification.

There are currently more than 130 research projects underway by faculty/student teams. Of these projects, some of the more promising are those dealing with acoustic propagation in the ocean, optical propagation studies and experiments, operational meteorological prediction, ocean boundary layer studies, electronics and communications, naval engineering, administrative sciences, and advanced development in computer acoustic processing.

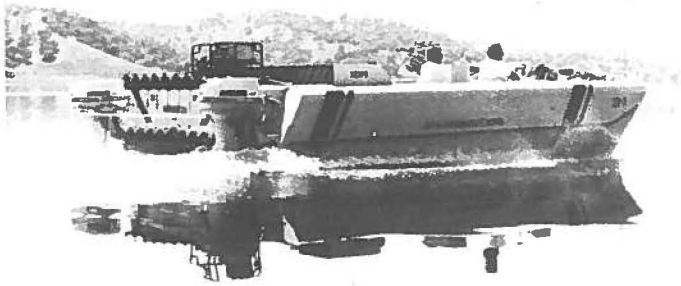
Robert R. Fossum, Ph.D.
Oregon State University
Dean of Research

Dr. Fossum came to NPS in November 1974 after five years with ESL, Inc., where he was Vice President and General Manager of ESL's Electro-magnetic Systems Laboratories. Dr. Fossum is a member of several government and industry panels and is an associate member of the Scientific Advisory Committee of the Defense Intelligence Agency. He is also a member of numerous professional societies including the Institute of Mathematical Statistics, Naval Institute, Mathematical Association of America and the Institute of Electrical and Electronics Engineers, Inc.



An interdisciplinary team involving five NPS academic departments is doing pioneer studies of laser transmission in the marine environment. Researchers from the Departments of Oceanography, Mechanical Engineering, Physics and Chemistry, Meteorology and Electrical Engineering are combining their talents in an effort to adapt laser transmissions for communications at sea.

Professor R.H. Stolfi of the Department of Government went to the Middle East to help evaluate the results of the October 1973 Arab-Israeli War for the U.S. government. The course of the tank warfare was of particular interest. Studies done from data collected by Professor Stolfi led to significant recommendations for improvement in U.S. military armor tactics, training and doctrine, and tank design.



The Department of Aeronautics continued its testing of the XR-3, a captured air bubble boat, under the direction of Professor D.M. Layton. The XR-3, which rides on a bubble of air generated by fans, is a prototype that is expected to lead to the design of a larger craft capable of speeds in excess of 100 knots. Fuel savings are estimated at up to 80% over conventionally designed craft.

A faculty and student reserach team, headed by Professor R.J. Renard of the Department of Meteorology, has developed a new method of drawing up climatological charts for midocean. The charts are based on studies of average fog conditions in midocean and are a step in the search for reliable methods of fog prediction. Data for the study came from various weather ships and the NPS Research Vessel ACANIA.

W.R. CHURCH COMPUTER CENTER

The W.R. Church Computer Center, containing an IBM 360/67 system, is a principal support facility for faculty and students in their research and classroom work. The IBM 360/67 is a large-scale, third-generation computer system which supports data processing services ranging from local batch-processing to remote-access time-sharing. The present hardware configuration includes two central processing units, a variety of storage devices, standard input-output peripheral devices, two CALCOMP plotters and teleprocessing control units for communication with slow-speed terminal devices (e.g., hard copy and visual display units) and high-speed transmission with mini-computers in some NPS laboratories.

Installed in March 1967, the system is operated as much as 168 hours per week. During 1974, approximately 260,000 batch jobs were processed. In a typical month, approximately 700 students use the batch-processing system and 150 others are active in the time-sharing mode. Seventy-five faculty projects were also supported during the year.

Many software enhancements were introduced in 1974 and include a dual processor version of IBM's OS/MVT (Operating System/Multiprogramming with Variable Number of Tasks) system, substantial improvement of the CALCOMP plotting package, design and programming of one-step, fast execution procedures for most common jobs in FORTRAN, COBOL, Linkage Editor, etc., and additional software monitoring tools for evaluation of systems performance.

New language capability included ANSCOBOL (American National Standard COBOL) and PL/M (Program Language/M), as well as ASSIST (a student assembler). The Control Program/ Cambridge Monitor timesharing system was modified to support new types of remote terminals, with new language capability.

A new keyboard and adaptor unit from Applied Digital Data Systems allows for use of any TV monitor as a display device for classroom or auditorium demonstrations of on-line, interactive use of computers.

Substantial programming support was provided to the School's administrative offices. In July, the registrar's office changed over to a new disk-based system designed and programmed by the Center's staff. Other projects included revisions to the information system for the Civilian Personnel Office and academic load forecasting and staffing programs. The Center's users' manual was completely rewritten to reflect recent changes. It now provides a comprehensive guide to all the Center's services.

The IBM 360/67 system has been expanded by the addition of IBM-compatible main and peripheral storage devices. One such item, the IBM 2701 Data Adapter Unit, will soon allow high-speed communication with terminals in NPS laboratories, giving access to large capacity storage and computing power.

In late December 1974, the physical layout of the IBM 360/67 computer system was completely revised to improve operating efficiency, allow attachment of new devices and permit future expansion.

LIBRARY SERVICES

The Dudley Knox Library continues to serve the needs of the research and instructional programs at the Naval Postgraduate School and its tenant commands. Testimony to this was an 11% increase in student per capita use of the library in the last 12 months. This use reflects an improvement in the quality and quantity of holdings and the development of special services that complemented programs in the curricular fields of engineering, physical sciences, managerial sciences, operations research, naval science and government.

In many respects, the past year can be described as a transitional period. Concepts conceived earlier proved operationally feasible. Two primary examples are the Research, Development, Test and Evaluation On-Line System (RDT&E) and the Dial Retrieval System. The library's RDT&E On-Line terminal has the capability of accessing the data banks of the Defense Documentation Center, which include more than one million technical reports. The Dial Retrieval System is a closed circuit TV system jointly operated by the library and the Educational Media Department of NPS. The Dial Retrieval System permits students to obtain repreated presentations on a selective recall basis for personalized learning. Sixty monitors are installed for student use.

At the end of the year, the library's collections included more than 400,000 books and bound periodicals, research and development documents, bibliographic volumes and pamphlet items. Research and development documents are accessible through SABIR3, the library's computerized information retrieval system. In addition to the compilation of computer-generated bibliographies on request, the library offers its patrons an SDI (Selective Dissemination of Information) Service. Faculty members and students who wish to avail themselves of this service may establish continuing subject interest profiles with the Technical Reports Branch. Subsequently, all input into the SABIR3 data banks is routinely searched and personalized bibliographies made available to the participants on a bi-weekly basis.

Special mention should be made of the retirements of three key staff members: George R. Luckett, Librarian and Professor of Library Science; Professor Janusz Kodrebski, Head Cataloguer; and Professor Edgar R. Larson, Reader Services Librarian. It is primarily as a consequence of Professor Luckett's dedicated efforts that the library collections have attained their present stature and the new library now stands in place of the constricted pre-1972 quarters.

NAVAL POSTGRADUATE SCHOOL FOUNDATION, INC.

The Naval Postgraduate School Foundation, Inc. was founded in December 1970 "to solicit, receive and administer contributions . . . and dispense charitable contributions . . . and otherwise aid, encourage and support the traditions for the Naval Postgraduate School."

During calendar year 1974, the Foundation successfully accomplished this stated purpose. Funds contributed by students, faculty and other friends of the Naval Postgraduate School were received by the Foundation to support the Dependent Scholarship Fund. The Foundation was able to award eight scholarships. These scholarships constitute an annual program to recognize dependents of faculty, civil service and military personnel who merit special consideration for past scholastic achievement and individual potential.

The "Rear Admiral John Jay Schieffelin Award for Excellence in Teaching" was funded by contributions to the Foundation and was awarded to Associate Professor Russell B. Bomberger, who is associated with the NPS Aviation Safety Program. The award is given annual to the faculty member most highly regarded as a teacher by his colleagues and students.

A 22-foot Columbia class sailboat was donated to the Foundation in the last year. It was assigned to the Naval Postgraduate School for use by the Sailing Association.

The staff, faculty and students of the Naval Postgraduate School are highly appreciative of the fine efforts of the members of the Foundation to promote the goals of the School. Through their dedication and assistance, broad opportunities for recognition and accomplishment are provided at Monterey.

NAVAL POSTGRADUATE SCHOOL FOUNDATION, INC. BOARD OF TRUSTEES

Robert M. Allan, Jr., President

Cyril Chappellet	Charles B. Kramer	Alfred Gawthrop
Mrs. C. Mark Thomas	Arthur C. Stewart	Jack Westland

FACULTY PUBLICATIONS

FACULTY PUBLICATIONS
1974

(Note: Because of space limitations, the following list does not include a significant number of papers published in the proceedings of meetings, presentations, NPS technical reports, reviews, etc.)

Amos, J.W. II, "Political/Military Implications of the War on the Day of Judgment," Naval Intelligence Command, Nov. 1974.

Andrews, Robert S. et al, "Measurement of Viscoelastic Porperties of Sediments." *Physics of Sound in Marine Sediments*, Plenum Press, NY, pp. 337-355, 1974.

Ball, R.E., et al, "A Comparison of Computer Results for the Dynamic Response of the LMSC Truncated Cone." *Computers and Structures*, Vol. 4, May 1974, pp. 485-498.

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THE NAVAL POSTGRADUATE SCHOOL

The Naval Postgraduate School began rather modestly at the Naval Academy in 1909 with ten students, three faculty members and one curriculum . . . marine engineering. Today, the School's civilian faculty of 250 teach more than 19 curricula in science, engineering and administrative science. In addition to Navy officers, the student body includes officers from the other U.S. uniformed services and more than 20 foreign allied nations.

The School's educational mission is accomplished through a civilian-Navy team of faculty and curricular officers. The relevancy of the education to the Navy's operational needs and the development of intellect are stressed. Advanced knowledge is increasingly becoming a necessity for the naval officer as an operator of weapons systems . . . as a tactician . . . as a strategist . . . and as an administrator.

The curricula offered at Monterey include administrative science, aeronautical engineering, electrical engineering with several options, environmental sciences, computer science, operations analysis, naval engineering, naval intelligence, and operational systems technology. Each of these curricula is designed to provide advanced professional knowledge to meet requirements unique to the military profession.

Because of the quality of its faculty, the Naval Postgraduate School ranks with the best graduate institutions in the country. More than 85% of the faculty hold the Ph.D. degree. Fully accredited by the Western Association of Schools and Colleges, the School presently awards degrees through the doctoral level. Specific engineering curricula are accredited by the Engineer's Council for Professional Development.

Research facilities at the Naval Postgraduate School are among the finest to be found in American educational institutions. They include an anechoic chamber, a linear accelerator, numerous computers and systems consonant with the various curricula, wind and smoke tunnels, wave tanks, electron microscopes, and other equipments and laboratories that are essential to a successful research program. All are housed in the modern buildings that make up the NPS campus.

THE CAMPUS

The grounds of the Naval Postgraduate School were once the site of the Hotel Del Monte, a hotel of the "grand" genre for more than half a century. The grandeur of the old hotel is still apparent in Herrmann Hall, the School's main administration building. The central portion of this building was constructed as the main hotel building in 1924, after the original building burned to the ground. The east and west wings of Herrmann Hall, untouched by the fire, still exist and date back to 1888.

The Navy leased the Hotel Del Monte during World War II as a site for preflight and electronics technician training schools. The Navy was able to purchase the building and grounds in 1948 for a small fraction of the replacement costs, when the hotel could no longer be operated economically. The Naval Postgraduate School was moved to this site from Annapolis in 1951. Also included in the original purchase was acreage, adjacent to the Monterey Airport, which presently is the location of the Naval Postgraduate School Annex. At this site are to be found additional academic and support facilities and elements of two tenant commands.

One section of land that was once the Hotel Del Monte's polo field has been converted into a fine 18-hole golf course. Another parcel, lying to the west, has been used to create attractive La Mesa Village . . . a community of Navy housing for 900 service families.

TENANT ACTIVITIES

Three important tenant activities are also located on campus, providing easy and mutually beneficial access to students and faculty. The Defense Resources Management Education Center is operated for the Department of Defense to educate high-level military and civilian personnel in executive planning, programming, budgeting, systems analysis, and resource management. The Fleet Numerical Weather Central is the master computer center and controller of the Navy's Worldwide Environmental Data Network. The Environmental Prediction Research Facility's mission is to conduct applied research in various disciplines of environmental science.

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